Mr RaRoe

POST OFFICE

tele communications

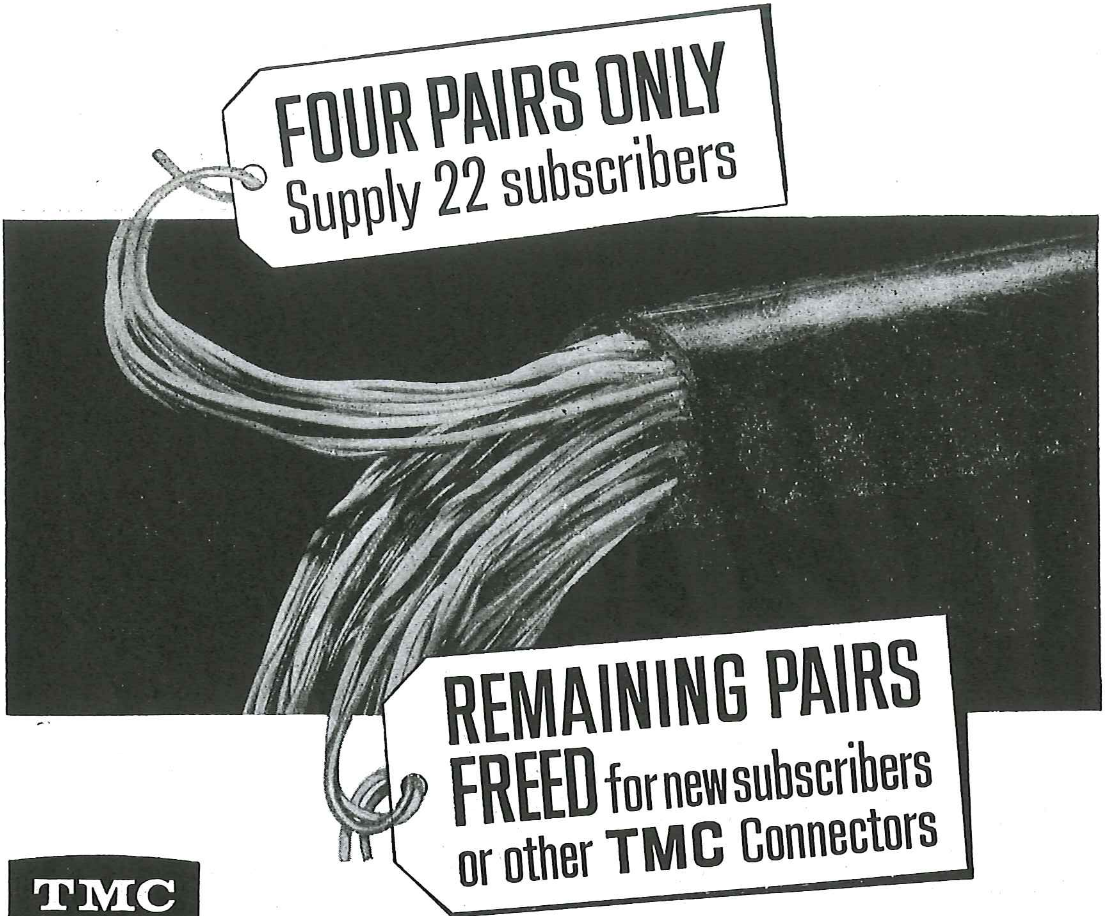
JOURNAL

ONE SHILLING

AND

SIXPENCE

WINTER 1962



TMC

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Post Office Telecommunications Journal

Published by the Post Office of the United Kingdom to promote and extend knowledge of the operation and management of telecommunications

Contents

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Vol. 14 *Winter* 1962 *No.* 4

A Special Effort Needed

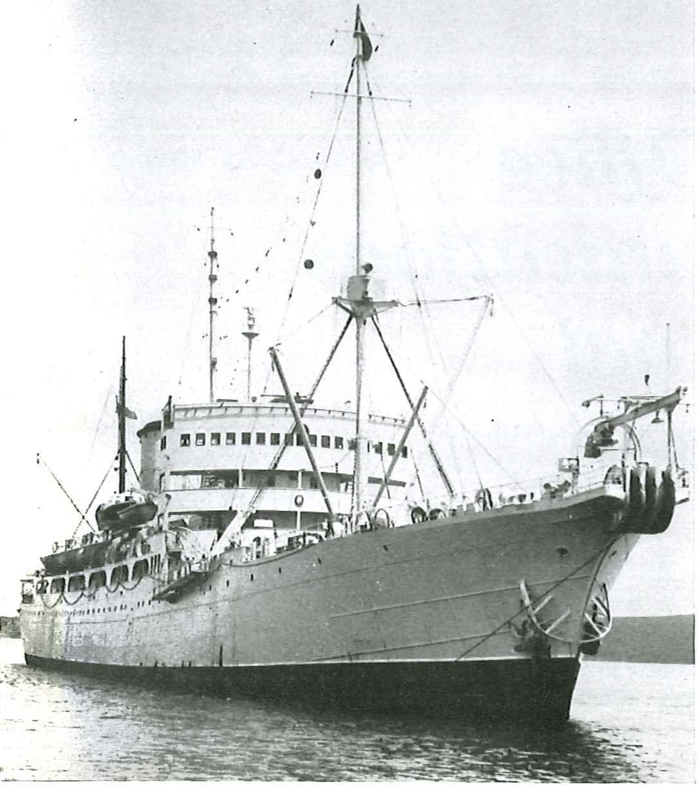
AS this issue goes to press the Post Office is preparing to play its part in a national drive to make Britain a more efficient and prosperous nation.

The British Productivity Council, representing management and unions, launched in November a National Productivity Year designed to focus attention on every possible means of raising efficiency and lowering costs.

The Post Office has an important contribution to make and the telecommunications side faces a threefold task. First, to demonstrate to industry and commerce the many and varied services available to help them increase their efficiency and productivity. Second, to show how industry and commerce can help the Post Office to raise its own efficiency by using its services effectively. And third, to stimulate joint productivity within the Post Office.

The Post Office can be justifiably proud of the rapid advances it has made in the past few years in increasing the efficiency of its telecommunications services and in the many ways—for instance, by the spread of Subscriber Trunk Dialling, the automatisation of the telephone service, the expansion of telex and of facilities for firms to transmit data automatically over the telephone and teleprinter networks—in which it has helped industry and commerce to become more efficient and productive. It has done a great deal, too, to streamline its organisation and methods and achieved considerable economies through automatisation and mechanisation.

But even all this is not enough. In National Productivity Year we must all make a special effort—management and staff alike—to speed and improve our services and raise our efficiency still further.



HMTS *Monarch*. She can carry up to 6,000 tons of cable.

In eight days HMTS *Monarch* sailed across the Tasman Sea to link Australia and New Zealand with a new lightweight submarine cable designed by the Post Office Research Branch and made by British manufacturers

MONARCH SPANS

AT eight o'clock in the evening of 30 May, 1962, HMTS *Monarch*, the British Post Office's biggest cable-laying ship, hove to off Muriwai Beach, in New Zealand's North Island.

For eight days, paying out a lightweight cable behind her, *Monarch* had ploughed across the Tasman Sea from Australia's famous Bondi Beach, 1,242 nautical miles away, to complete yet another submarine cable-laying operation: this time forging a vital link in the Commonwealth Pacific Cable system (COMPAC) which opens up a new era in communications in the Southern Hemisphere.

Thanks to *Monarch* and to the British research scientists, engineers and manufacturers who had designed and made the revolutionary type of cable and repeaters, Australia and New Zealand now have a communications link which can provide 80 telephone circuits of extremely high quality and which is initially equipped for 12 two-way circuits between Sydney and Auckland. Previously there were only four radio-telephone and four radio-telegraph circuits between the two countries. When all the presently-planned sections of the Commonwealth round-the-world cable system are completed to connect Britain, Canada, Hawaii, Fiji, New Zealand, Australia, New Guinea, North Borneo, Singapore, Malaya and Hong Kong, the system will provide 80 voice channels which could alternatively be used for up to 60 telegraph or teleprinter channels each or for transmitting music, high-quality voice broadcasts and photographs. At present there are only 13 radio-telephone and 28 cable and radio-telegraph circuits between Australia and New Zealand, North America, Britain and Europe.

Beach-inspector A. Laidlaw, who swam out from Bondi Beach to bring ashore the cable carrier line, attaches it to the armoured cable.

THE TASMAN SEA

The cable between Australia and New Zealand—known as the Tasman Link—was opened for public service when the prime ministers of the two countries spoke to each other between Paddington (Sydney) and Auckland. It was the culmination of many months of careful planning, technical achievement, consultation between the member countries of the Commonwealth Cable Scheme, for which Mr. R. J. Halsey, Director of Research of the British Post Office, is leader of the development group for COMPAC, and sheer hard physical work.

When H.M.T.S. *Monarch* set sail from Bondi Beach on her way to New Zealand, the land sections and the shore-end cables in Australia and New Zealand had already been laid. At the Australian end the land cable was placed through underground ducts from the Australian Overseas Telecommunications Commission's terminal at Paddington to a cable room beneath the esplanade at Bondi Beach. In New Zealand, two land cables—one from the Auckland terminal station at Takapuna to Takapuna Beach, the other to Muriwai Beach—were laid.

The laying of the shore-end cables was carried out by the cable repair ship *Retriever*, owned by Cable and Wireless Limited, which tackled the New Zealand end first. After completing the cable off Takapuna Beach, ready for the Auckland to Suva cable to be laid later this year, and the one off Muriwai Beach, *Retriever* sailed to Sydney where, on 19 April, the land section and the shore-end cable were joined. First a beach inspector swam out to a launch anchored off the beach and then swam back again with a light line attached to a heavier

OVER

Monarch Spans the Tasman Sea *(Continued)*

rope which, in turn, was joined to the cable on board *Retriever*. The cable, buoyed up by floats, was hauled ashore and then dug into a deep trench in the sand while *Retriever* paid out more cable and dropped its end, attached to a heavy earth plate, about a mile out to sea. Then the "working" cable, double-armoured for the first five miles and single-armoured for the rest, was laid to a spot some ten nautical miles offshore.

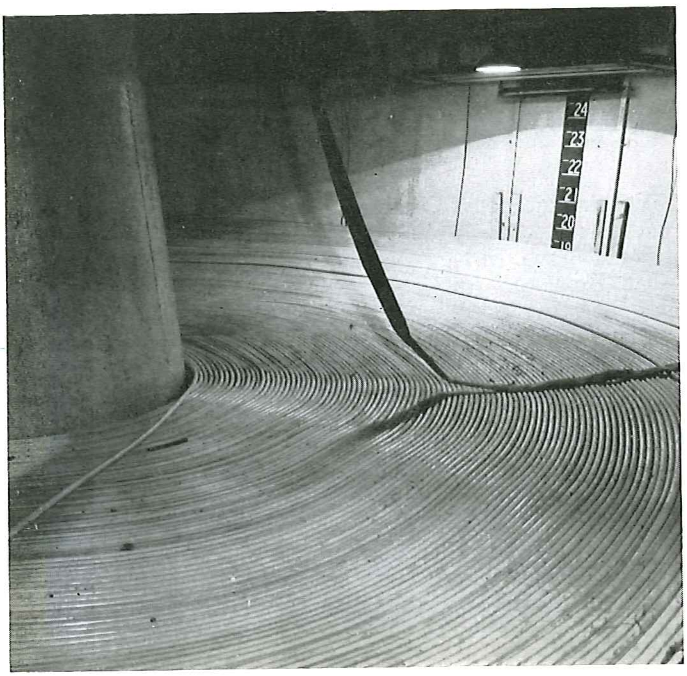
Several weeks later *Monarch* picked up the shore-end cable which had been raised to the surface by *Retriever*, and joined it to the cable on board. Then, after the cable had been tested, *Monarch* set off for New Zealand, accompanied by *Retriever* which had previously marked the route with buoys at intervals of 250 nautical miles. The first of the half-ton, ten-feet long submerged repeaters which were attached to the cable every 26 nautical miles, was dropped overboard a mile and a half off shore. For the first 17 miles single-armoured cable was used but after that the special lightweight, unarmoured cable was attached and laid for the rest of the voyage.

These repeaters, similar to those used in the TAT 1 cable (a detailed description of which appeared in *Trans-Atlantic Telephone Cable*, a supplement to the *Journal*, Autumn, 1956) can withstand pressures of up to four tons a square inch at 3,500 fathoms. Costing £18,000 each and all their metal parts (including the wires connecting the components) gold-plated, the repeaters have two systems working in parallel so that if one half fails the other continues to operate. The valves in the repeaters are energised by a direct current, supplied from the land terminal stations, which passes along the cable's inner conductor and each repeater in turn and then returns by way of the outer conductor and the sea.

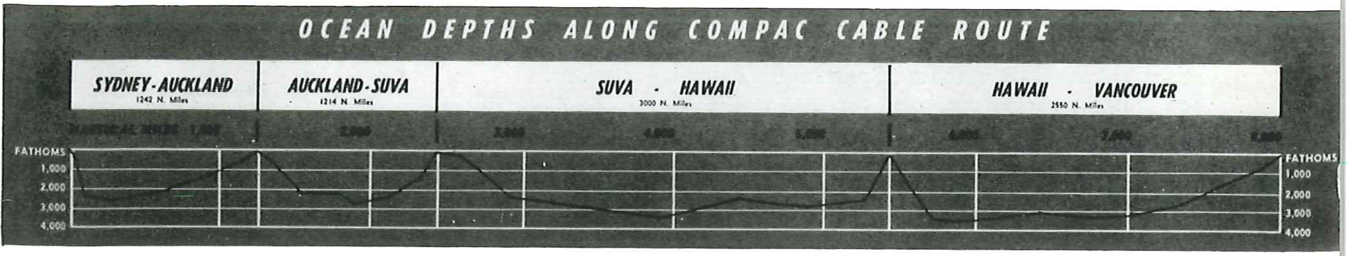
The cable used on the Tasman Link is the same as was used in laying the CANTAT Cable. It is the revolutionary, lightweight co-axial cable designed by the Post Office Research Branch at Dollis Hill and manufactured by British firms.

Submarine cables must have great strength and until recently derived it from outer wrappings of steel wire which also protect them against ships' anchors, trawls and rocks in tidal waters. Although

An unusual angle shot of the lightweight co-axial cable in one of HMTS *Monarch's* four cable tanks.



CS *Retriever* stands off Muriwai Beach as the first light line attached to the shore-end cable is hauled ashore.



the outer armour is necessary, therefore, for cable in coastal water, it serves no real purpose for cable laid in the still depths of the oceans. It also has the considerable disadvantage of commonly causing the cable to kink or twist in laying and recovery.

The new cable obtains its strength from a central core of 43 high-grade steel strands, together little bigger than a man's smallest finger, which can withstand a pull of more than four tons. It is only one-and-a-quarter inches in diameter, a third of the weight of an armoured cable of the same thickness and, because of the arrangement of the steel wires, is free from any tendency to twist. Around the central core is a copper tube (the inner conductor) which carries the electrical signals of the working cable and over this a polythene insulation, which, in turn, is covered by six aluminium ribbons called "return tapes." The copper, polythene and aluminium ribbons form the co-axial tube, or electrical working part of the cable. A polythene ribbon is wound over the aluminium tapes and then come a layer of aluminium foil, which acts as an electro-static screen, a cotton tape impregnated with a corrosion inhibitor, and, finally, the outer polythene sheath. For protection against mechanical damage in shallow water an armoured lightweight co-axial cable is used. In this, the armour is applied externally to a core about two-thirds of the diameter of the unarmoured lightweight cable and designed so that a repeater section of about 18 nautical miles simulates a 26-nautical mile section of the lightweight cable.

Since H.M.T.S. *Monarch* was allowed a latitude of only one mile of cable over the 1,242 miles from Bondi Beach to Muriwai Beach, accurate navigation

OVER

THE FOURTH OF A PROUD LINE

HMTS *Monarch* (8,422 tons) is a twin-screw vessel built in 1946, since when she has laid cables in many parts of the world, in places as far apart as Singapore and Honolulu, Greenland and Montevideo.

Monarch, which laid the first trans-Atlantic telephone cable in 1956 and CANTAT, the first link in the Commonwealth round-the-world cable scheme, in 1961, has a maximum speed of 14 knots and can carry between 5–6,000 tons of cable in her four 41-ft diameter cable tanks. She is commanded by Captain O. R. Bates and has a crew of 138.

Monarch is the fourth of her line. The first, a wooden paddle vessel, was the first to be fitted as a cable ship. She was condemned in 1870 and replaced in 1883 by the second *Monarch* which was the first to be built as a cable ship. She was sunk by a mine in World War One and replaced in 1916 by the third *Monarch* which was also mined in 1945.

Captain O. R. Bates, HMTS *Monarch's* Commander.

Until recently the present *Monarch* was the biggest cable-laying ship in the world. She has relinquished this title to *Neptune*, a 12,000-ton German cable-layer which can carry 3,000 miles of cable. The United States cable-laying ship *Longlines*, at present under construction, is also bigger than *Monarch* by some 1,500 tons.

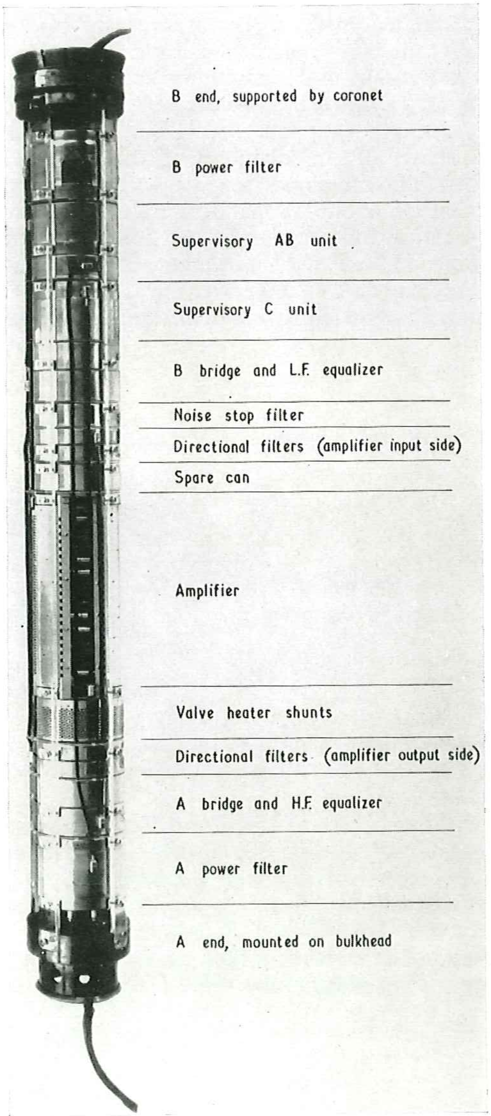
Monarch *(Continued)*

was essential. This presented a big problem, for little was known about the area, parts of the Tasman Sea suffer from severe cross-currents and there were no electronic navigational aids. Added to this, the sky on most nights during the crossing was overcast so that star sights were impossible. To prevent the repeaters sinking more quickly than the cable to which they were joined each was attached to a parachute before being cast overboard.

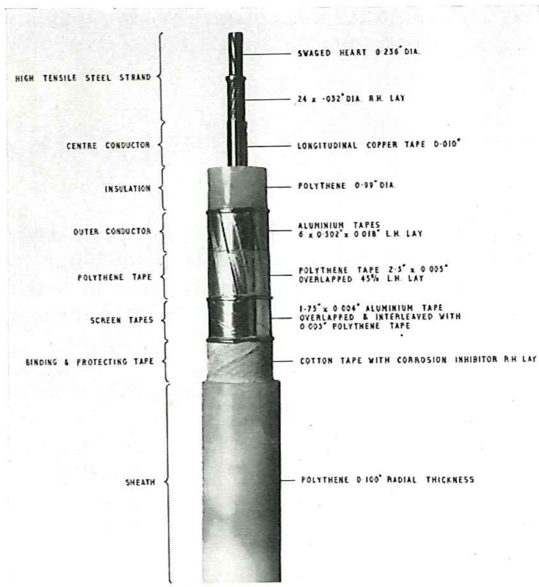
Because of bad weather the cable laid by *Monarch* and the shore-end cable at Muriwai Beach were not joined until 2 June when, at 6.20 a.m., the first test signals were passed over it between Paddington and Auckland terminal stations.

Another job well done, H.M.T.S. *Monarch* returned to Britain in August and prepared to take on board 1,200 nautical miles of lightweight cable for the New Zealand to Fiji section of the COMPAC link which will connect Vancouver and New Zealand.

Monarch will later lay most of the cable from Vancouver to Hawaii, in two operations, while the Cable and Wireless cable ship *Mercury* closes the gap between Fiji and a point north of Hawaii in three operations.



Left: The internal unit of the submerged repeaters, of which 50 were used on the Tasman Link—one every 26 nautical miles. Below: A section of the lightweight cable.



NEW CLOCKS FOR TIM

A prototype model of the new speaking clock which will be normally accurate to one twentieth of a second.

THE Post Office is searching for the Girl —or the Man—with the Golden Voice from among its 40,000 women and nearly 14,000 men telephone operators and supervisors.

When the Voice is finally selected, sometime in December—the essential qualities are purity of tone and clarity of enunciation—it will be recorded on the new TIM speaking clocks, which have been designed and built by engineers at the Post Office Research Station at Dollis Hill, and its owner will receive £100.

The new TIM speaking clocks, which will replace the present ones early next year, will be cheaper to install, maintain and operate and, because of the introduction of new techniques, the quality of the recordings will be much better.

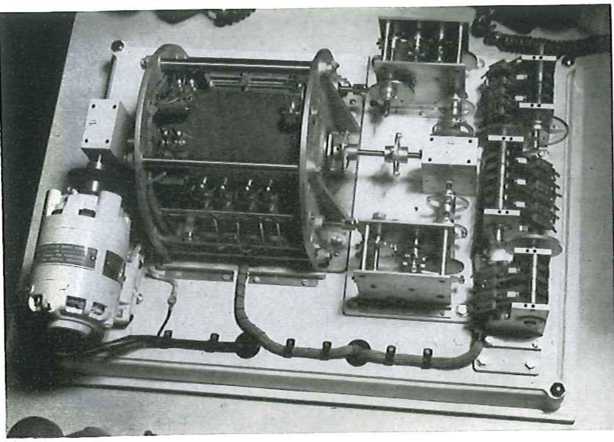
The TIM service, which gives the time to nearly 100 million callers a year, was introduced in London in 1936 with a pair of speaking clocks at the Holborn Exchange. It was later extended throughout the country and a second pair of clocks was installed in Liverpool in 1942 to safeguard the service against breakdowns.

The main requirements of a speaking clock are that it should keep accurate time and that the sound record should not wear out with continual playing. The only recording method available in 1936 which met the latter requirement was the photographic technique used in sound films, the recording being played by scanning it with a beam of light. In the present TIM machines the phrases used in the time announcement are recorded photographically as concentric tracks on four glass discs, each 12 inches in diameter. One carries the phrase "*At the third stroke*" and the six different seconds announcements. Another carries the 12 hours, "*it will be one*" and so on and the remaining two have the minutes and the pip of tone which marks the exact time recorded on them. The outputs from the photo-electric cells associated with the discs are combined to form a complete announcement.

The speed of rotation of the mechanism, and hence its time keeping, is controlled by a pendulum swinging freely in a temperature-controlled cabinet. With hourly corrections from the Royal Observatory the present TIM can guarantee correct time to within plus or minus 0.1 of a second.

Because of the optical focussing necessary on the speech tracks the mechanism has to be very well made and the clock is, in fact, a fine example of precision engineering which still shows no sign of wearing out. Nevertheless, for a variety of reasons, it has been decided to replace the present clocks with ones of a new design. The electrical wiring of the old clocks has become very fragile and would have to be renewed in the near future; by present-day standards the speech quality of the recordings is not very high; and the background noise of the photographic sound track is clearly audible.

The new clocks use magnetic recording. Conventional magnetic tape is unsuitable for this purpose since both the tape and the heads would wear out very quickly. Recently, however, a new magnetic recording material made of Neoprene loaded with magnetic iron oxide and in tubular



A close-up of a prototype announcing machine in the new clock. Speech is recorded on magnetically-loaded Neoprene.

The TIM speaking clock installed at the Holborn Exchange in 1936 and which still shows no signs of wearing out.

form so that it can be stretched onto a drum, has become available and is being used in the new TIM clocks. This material has a resilient non-abrasive surface and, so long as it is covered by a thin film of silicone oil, neither the material nor the reproducing heads appear to suffer any detectable wear over very long periods.

The constituent parts of the speech announcement are recorded as circular tracks on a thick tyre of magnetically-loaded Neoprene fitted over a metal drum, which rotates at a constant speed and is driven by a motor running in synchronism with a quartz-crystal-controlled oscillator. The magnetic replay heads are lightly sprung against the Neoprene surface and the announcement assembly is controlled by gears and cam-operated contacts driven positively from the main drum shaft. The pips, which are pulses of 1,000 c/s tone, are not recorded on the drum but derived from the oscillator.

The clock automatically checks and corrects itself against Observatory time once a day and is not normally expected to be in error by more than five thousandths of a second. For a number of reasons, however—chiefly delays in the distribution network and irregularities in the motion of the earth which complicate the definition of time—this degree of accuracy cannot be passed on to the public. The published claim will be "normally accurate to one twentieth of a second." Because of its high inherent accuracy the clock will be capable of running for several days without correction.

The TIM service will be provided, as before, by a pair of clocks in London, located this time at Trunk Control, North, near King's Cross, and another pair at Liverpool, each installation normally serving half the country. One of the clocks in each pair will always be "on the air" and the other will run as a standby, to be automatically switched in if any part of the announcement fails on the working clock. If the two clocks in a pair, which are controlled by separate oscillators, become out of step by more than one twentieth of a second, or should they start repeating announcements which differ in any way, both clocks are automatically taken out of service and the distant centre then supplies the entire country.

Transistors have been used throughout for the new TIM installation, with consequent savings in space and power. If the public mains supply fails the exchange battery takes over without a break.

The real advantage of the new clocks to the subscriber will be the greatly improved quality of the announcement. But the greater degree of accuracy, with daily instead of hourly checks, will mean that the clocks require much less attention, thus considerably lowering the running costs. And because the form of magnetic recording on the new clocks does not need the extremely high standard of precision workmanship of the old clocks the capital cost will be only about a quarter of the present day cost of the old installation.

R. R. WALKER, B.Sc. (Eng.), A.M.I.E.E.

To speed its overseas telegraph services the British Post Office has introduced a new system of working—called Gentex—which allows operators to transmit telegrams direct to the appropriate delivery office. Plans are in hand to extend the system to many more countries

GENTEX—And How It Works

By R. A. JACKSON

IN the not-too-distant future many countries may be able to exchange all or the bulk of their public telegraph messages through a communications network called Gentex.

Gentex, which is already in operation between Britain, the Netherlands, Western Germany and Belgium, is an automatic telegraph office-to-telegraph office service based on the principles of telex switching and through which telegrams are transmitted direct from the office nearest the sender in one country to the office nearest the recipient in another.

Normally, overseas telegraphs are transmitted

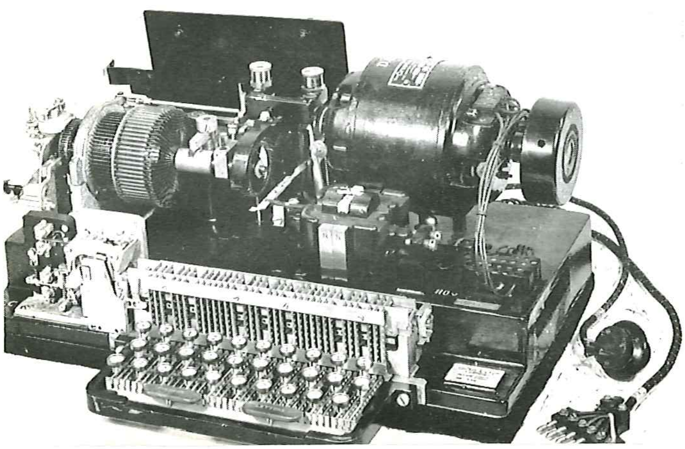
Part of the Gentex forwarding zone and the distribution point. The operators use page machines for sending.

first between a few large central offices and then re-transmitted to the local offices by landline or radio links. Now, by the dialling of a code, Gentex sends its messages direct to and from the local offices, saving time, money and achieving greater accuracy in the process.

Before World War Two most of the world's public telegraph systems were operated on a point-to-point basis with manual re-transmissions at large central offices and the British Post Office inland system conformed to this general pattern. Overseas telegraph services (owned by private companies) operated in a similar manner and, until the early 1920s, in comparatively short hops with manual re-transmission from one cable to another at the cable offices. Transit centres, with large numbers of operators, were positioned at strategic points such as Carcavelos, Gibraltar, Fayal, Aden and so on.

It had long been recognised that manual re-transmissions at intermediate centres could largely be avoided by using a switching system to connect the various offices and probably the first example of this method of working was the Umschalter system introduced by the Electric and International Telegraph Company in 1854. This was quickly followed by other systems, probably the most notable being the Metropolitan Switch (see *Farewell to the CTO* elsewhere in this issue). The adoption of the regenerator in 1922 made it possible to connect the various sections of overseas cables electrically without the intervention of operating staff at intermediate centres. A new system of switching enabled combinations of signals (known as "attacks") to be sent to the controlling station which could switch the cable connection from one cable to another or cause

The teleprinter type 3a, introduced in the late 1920s and used extensively until superseded by new machines.



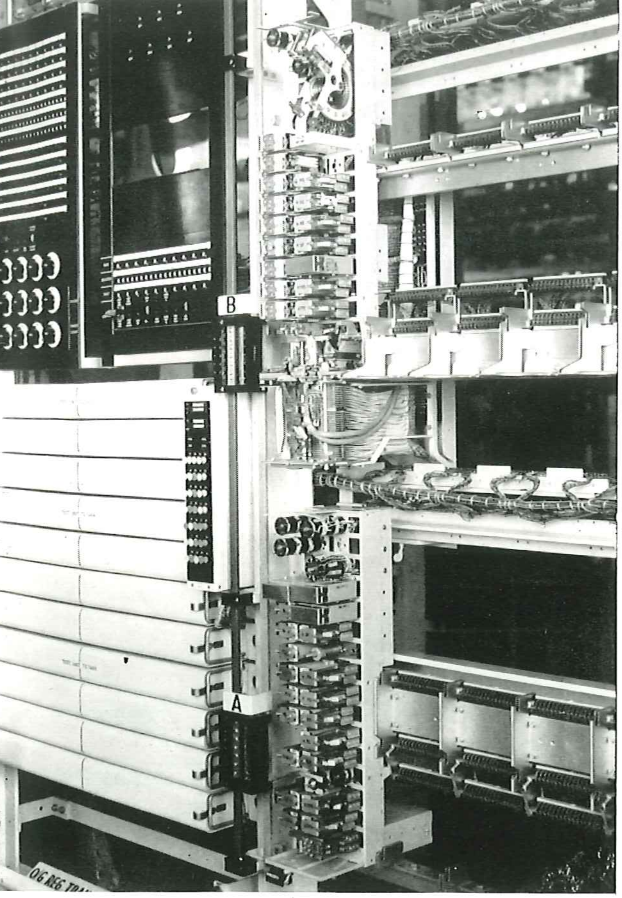
messages to be printed at the desired intermediate cable station. An alarm signal (bell call) could also be given to draw the attention of intermediate stations to the circuit and this system is still in use today.

The first telegraph systems were based on the use of a semaphore but this was soon followed by the sounder using the Morse code, though very long overseas cables (such as those across the Atlantic) used a mirror galvanometer and a beam of light which required two operators, one to read the light, the other to write down. As signalling systems improved with the introduction of electrical and mechanical relays it became possible to use the Creed reperforators and teleprinters based on the two-unit Morse code. A disadvantage of the Morse system is the differing number of elements required for each character and the need for the receiver speed to be adjusted to that of the sending machine and this led to the development of the Murray five-unit code and modern teleprinter in which each character had the same number of elements and each merely required isochronism between the sending and receiving machines. The main public telegraph circuits in the British Post Office inland system were converted to teleprinter working between 1927 and 1931.

Introduction of TAS

The voice frequency telegraph system, allowing the connection of six, 12 or 18 telegraph circuits on one telephone circuit and the rapid development of automatic telephony with well established switching techniques, paved the way for the development of fully automatic internal telegraph systems and in 1935 a *Telegraph Re-transmissions Committee* was set up to consider the practicability of such a scheme. As a result, equipment was developed and tried experimentally in a number of centres in London and the provinces and from these tests it was decided, in 1937, that the entire inland system should be converted to automatic switching.

World War Two interrupted this project but in 1944 the British Post Office began to set up a switching system for public telegraph traffic based on six zone centres and using manual switchboards. This system worked very well and in 1950 a start was made to convert the system to automatic working. The scheme was completed in 1954 and is now known as the Teleprinter Automatic Switching (TAS). Most European countries



not be connected direct to his correspondent and in 1932 a new service—Telex—was opened in Britain for public service, using ordinary telephone circuits to connect subscribers and transmitting telegraph signals by voice frequency signals. An independent telex network was opened in 1947 to provide international service only.

◀ The international outgoing register-translator used to convert the Post Office's Strowger-type dialling pulses into the keyboard signals required for other systems.

In 1954 the original national service was closed (it had fewer than 1,000 subscribers, each making an average of only one call a week) and the new telex network, based on a manually switched system and using separate telegraph channels was opened. The new system, which has grown very rapidly (it now has some 9,000 subscribers) is completely converted to automatic working in Britain and also allows automatic access to most Continental countries.

Although the TAS and telex services are carried on separate networks in Britain, there is no reason, in principle, why the two networks should not be combined and consequently some countries, for example, Holland, have developed one system for both services.

similarly had to rebuild their internal telegraph services after the war and took the opportunity to install automatic switching.

This change in the method of working public telegraph networks reflects the change in prevailing economic conditions. When telegraphy was first introduced manpower was plentiful while circuits were in extremely short supply and expensive. It was necessary, therefore, to operate the circuits at their maximum capacity even at the expense of manual re-transmission. Now the position is reversed. Modern developments in terminal equipment and the development of multi-channel carrier and voice frequency systems have reduced the cost of individual circuits while manpower has become correspondingly expensive. Consequently it is now sound economics to provide the larger number of channels required for a switching scheme in order to save staff at the switching centre.

Parallel Development of Telex

If telegraph offices could be connected to each other by means of a switching system there seemed to be no reason why the filer of the telegram should

The success of these internal switching systems not unnaturally suggested their further exploitation by interconnecting those of various countries, enabling an office in one country to send a telegram direct to the office of destination in another.

At meetings of the International Telegraph and Telephone Consultative Committee (CCITT) held in Geneva in 1955 this proposal was discussed and it was agreed "that as most European countries now had internal teleprinter networks based on the start-stop teleprinter system the time was opportune to interconnect these networks and thus enable the exchange of international traffic by this means." This system was at first called European Switched Network (ESN) but at a CCITT meeting in 1956 it was renamed Gentex. Details of signalling systems were decided, answer back codes devised and operating rules prepared.

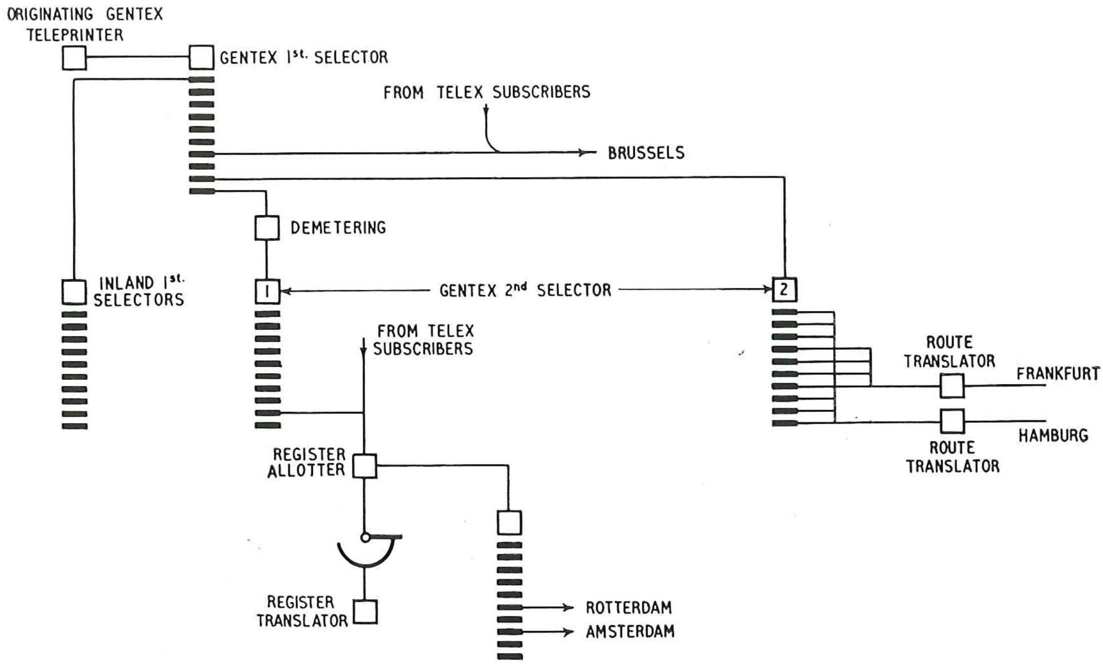
The proposed schemes were flexible and allowed participating countries to make the best use of their

OVER

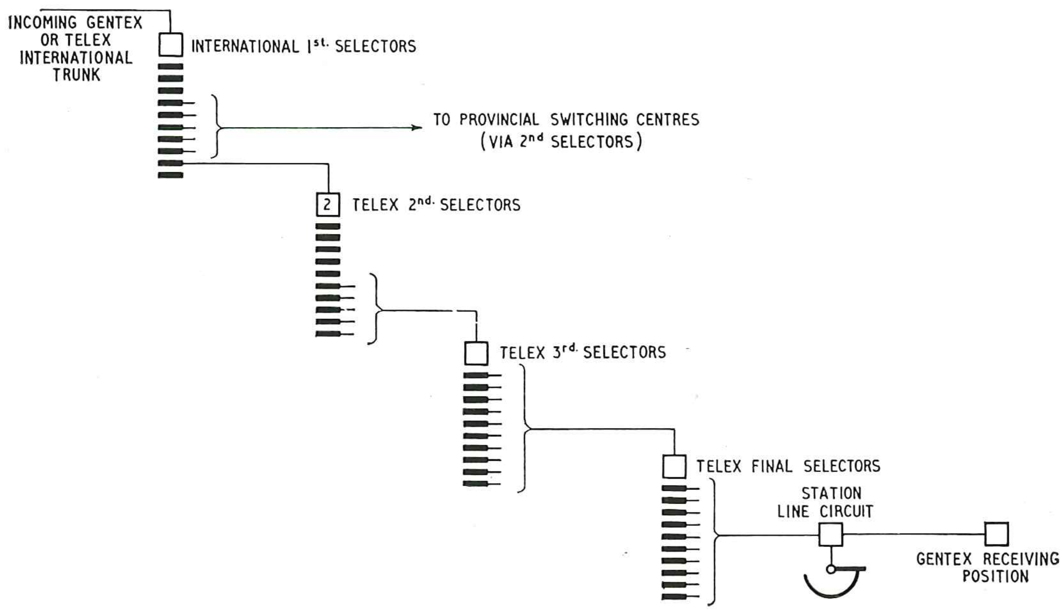
GENTEX *(Continued)*

existing networks. Two types of signalling system were adopted and it was agreed that the form of selection used to obtain the required number may also differ, either dial or keyboard selection being used. Britain, in common with other members of the CCITT agreed in principle to join the scheme.

By early 1959 the Netherlands Administration was pressing Britain to exchange public telegraph traffic with offices in Holland through the Netherlands Gentex network of telegraph offices (now 67), all of which could deal with international traffic direct.



These two diagrams illustrate (above) the outgoing and (below) the incoming Gentex trunking elements. The switching equipment is accommodated in the Fleet Telex Exchange.



At that time most of the British terminal telegraph traffic to and from Continental countries passed through the Central Telegraph Office (Cable Room) in London. It was agreed that terminal traffic between the Netherlands and Britain would be exchanged by Gentex and for this purpose the Cable Room was provided with circuits to the Amsterdam switching centre and thus was able to function in a similar manner to any other office connected to the Netherlands network.

Eight circuits were provided, three for outgoing traffic and five for incoming. In addition, two point-to-point circuits were retained, one each to Rotterdam and Amsterdam. This service opened in 1959 and used keyboard selection to obtain the required office. It worked very well and in June, 1960, when the Cable Room was closed, it was transferred to Electra House with other Continental circuits.

Extension to West Germany and Belgium

Both the Belgian and West German administrations have very well developed Gentex systems, the former with seven offices and the latter with 243, and each has been keen to exchange traffic with Britain by this means instead of using point-to-point circuits from one or two main offices with the attendant disadvantages of re-transmission to and from other centres. Since Britain had agreed to participate in the Gentex scheme a committee was formed in the External Telecommunications Executive at the end of 1960 charged with introducing Gentex as soon as possible within the framework of more comprehensive proposals for the mechanisation of the overseas telegraph service. The committee's first task was to decide how the internal switching in Britain should be accomplished. With two distinct telegraph automatic switching networks already in operation—the inland Teleprinter Automatic Switching network (TAS), and the telex network—it was obviously uneconomic to construct a third for Gentex traffic, so it was proposed that the existing networks should be used where possible.

Initial proposals favoured the use of the TAS system but the signalling conditions are not suitable for international traffic. The next proposal was to use the Telex network for incoming Gentex traffic and the TAS network for outgoing traffic. Offices connected to the Gentex system would then have a separate group of machines for outgoing Gentex traffic, obtaining access to the international circuit through a link to be provided between the TAS switching centre in London (Judd Street) to the international section of the Telex Exchange (Fleet Building). This link would terminate on a separate rack of first selectors to be installed in the Telex Exchange.

Cost studies were undertaken by the Engineering Department and from these it became clear that the high circuit loading on the outgoing Gentex circuits made it more economic to provide direct circuits between the offices to be connected to the system and the Gentex first selectors in the Telex Exchange. The final proposals then became: 1. Incoming traffic to be carried on ordinary telex lines, the British Gentex offices being connected to Telex final selectors; 2. Outgoing traffic to be carried on direct circuits connected to Gentex first selectors in the Fleet Telex Exchange.

The method of obtaining access to other countries varies. In some instances there is only one route from Britain carrying both telex and Gentex traffic (for example, Brussels for Belgium). In others, more than one route is involved (for instance, Frankfurt and Hamburg for West Germany) which, depending on the make-up of the system in the distant country, may not always be combined Gentex/telex routes.

Where more than one route to countries using dial selection systems is involved a special piece of equipment termed a routing-translator, and/or additional selectors, are used to route the call to the correct centre in the distant country. Where necessary special routing-translators carrying only Gentex traffic are provided.

Register-Translators

Register-translators are used to convert from one type of selection to another so that, for example, the operator in Britain uses the dial to select the whole of the required number on a call to the Netherlands even though keyboard selection is used in the Netherlands system. The register-translator also decides which route to use when there is more than one access point.

The outgoing (or calling) teleprinters are connected directly to the Gentex first selectors (unlike the TAS system where a station line circuit is used) because of the high calling rate and occupied time on each circuit. From the first selectors the calling operator can gain access to Belgium by dialling 4. This route, which ends in Brussels Telex Exchange, is shared with telex subscribers.

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Operators at work in the Incoming Gentex Section. In this office all incoming messages are received on tape machines and then gummed down on forms for delivery to the recipients in the normal manner.

GENTEX (*Continued*)

Access to Germany is obtained by dialling 2. As there are two points of entry into the German system it is necessary to know the initial digit of the called number to decide on which route the call should be connected and so the first 2 dialled by the operator takes the call to a rank of second selectors. The operator now dials the first digit of the required German office which is recorded in the second selector, thus deciding which route to Germany is required. The routing-translator equipment repeats to the distant German exchange the digit used to step the second selectors.

Calls to the Netherlands are obtained by dialling 121. Here the first digit routes the call to a rank of second selectors on level one through a "de-metering" relay set which prevents the Gentex calls being recorded on the trunk route international accounting meters. Level two on these selectors gives access to a register-translator through the register-allotters (hunters). The last digit (1) is used in the register-translator to indicate that the call will be for the Netherlands (register-translators are shared by several routes).

The register-translator determines from the number dialled whether the call should be connected over the Rotterdam or Amsterdam routes, and then, having selected the route, repeats the number dialled by the operator (which has been stored in the translator) but in teleprinter keyboard signals, since this is the type of selection used in the Netherlands system.

Incoming calls arrive over the international routes at the international first selectors. From the first selectors calls can be connected either to other switching centres or through second, third and final selectors to the Gentex receiving positions in Electra House, London.

At present a limitation is placed on the maximum number of circuits on one number group since telex final selectors provide only for up to ten lines in any one group—that is, 2/10 PBX final selectors—though these will soon be increased to 20. Although the capacity of some groups can be increased by adopting split bank working it is desirable to limit traffic to the capacity of a group of ten circuits if possible. Thus, incoming traffic is divided by the distant country into messages intended for the London postal area and other traffic, and the appropriate number is dialled. This arrangement results in two fairly equally loaded groups of eight and nine circuits respectively.

Initially, all traffic over the Gentex routes will continue to pass through Electra House and a section of the fourth floor has been set aside for Gentex working. The two zones have had to be laid out within the framework of the existing belt system since the time allowed for the introduction

of the scheme precluded any major construction work. One zone (45) carries outgoing traffic which is received at the "drop point" by belt from the floor distribution table. Here, traffic is numbered in an outgoing series and routed by writing the dialling code on the face of the telegram. The telegram is then passed to an outgoing operator for onward transmission. Fifteen teleprinters with page printing local record facilities have been provided for outgoing traffic and since the service was opened one of the circuits has been equipped with an automatic transmitter to deal with very long messages. After transmission the message and its page copy are passed to the padding (filing) section at the end of the zone to be filed in numerical order.

Because of the large number of offices connected to the Gentex network it would be impracticable to have a separate numbering series to each office as is the practice on the existing point-to-point circuits. As in TAS traffic, proof of the correct transmission of a message is by exchange of answer back signals at the beginning and end of the message.

The other zone (No. 43) is for incoming traffic from Gentex circuits. It also contains a TAS receiving section for traffic from inland offices in Britain intended for onward transmission by Gentex (and other circuits on the same floor). After gumming down messages are carried by belt to the zone numbering point and then to the floor distribution table. Incoming machines have been arranged in order of automatic selection so that operators can concentrate on early choice machines during periods of light traffic.

A point-to-point telegraph circuit has to be staffed continuously while in operation since traffic may arrive at any time and this leads to uneconomic staffing where a number of lightly loaded circuits are involved. There are some 300 offices connected to the present system and traffic between any two follows a pure chance law. Traffic records since the opening of the British system also show that traffic has a familiar "busy hour" pattern.

With a switching scheme it is possible to take advantage of this pattern and only staff the machines needed to carry traffic at any given time. It is customary to assess the requirements in half-hourly periods and to provide staff accordingly. Thus, while it may take more operator time for each individual message, the system as a whole requires fewer man-hours a day, allowing for routing and so on, than would be needed for the displaced point-to-point circuits.

The present method of working Gentex in Britain is an interim arrangement. Soon the Post Office hopes to open overseas telegraph area offices in London and the provinces which will be connected to the Gentex system and be able to exchange traffic direct with other Gentex offices. The system will also be extended first to France and Italy and later to other countries as equipment and accommodation become available.

The level of traffic in the present Gentex section is about 2,300 messages a day in each direction, representing about 10 per cent. of the total acceptance and delivery of traffic in Britain. When France and Italy are connected, total traffic will be in the order of 5,400 messages daily in each direction, some 23 per cent of the total.

★ The author acknowledges the assistance of his colleagues in the Operations, Mechanisation and Engineering divisions of ETE and in the Telegraph Manager's Office in the preparation of this article.

The outgoing numbering and routing point showing operators consulting visible, index files and placing the dialling codes on the telegrams before they are sent on their way.

Colonel D. McMillan, CB, the present Director of ETE. An engineer, he was appointed in 1955.

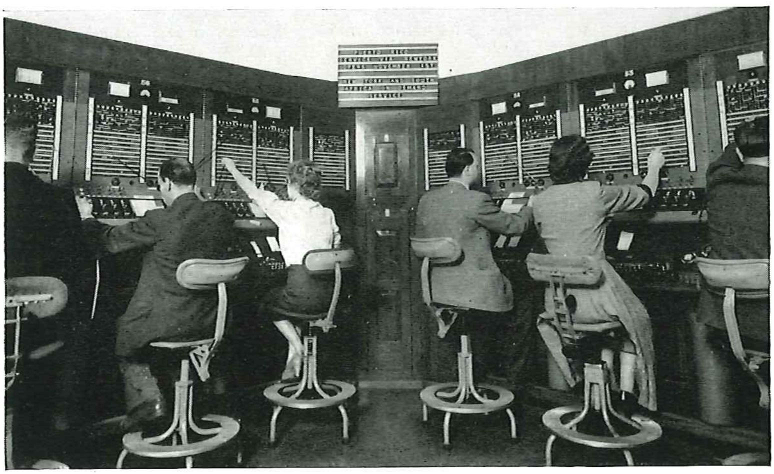
The External Telecommunications Executive—the youngest department in the Post Office—has completed the first ten years of its life.

ETE IS TEN

ON 1 October ten years ago a unique Post Office Headquarters department was born.

It was the External Telecommunications Executive and its unique task was both to administer and to operate overseas telecommunications services, a combination of responsibilities of the greatest significance in a sphere where policy and planning intimately influence day to day working.

The ETE Headquarters has four branches—Operations, Planning, External Relations and Engineering. Its operational responsibilities are discharged through the Overseas Telegraph Centre at Electra House, the International Telex Exchange (at present divided between Fleet Building and the Central Telegraph Office but soon to be concentrated at Fleet), the International and Continental Telephone exchanges in the Faraday and Wood Street buildings, the Radio Telephone Terminal at Brent (the technical control point for radio-telephone circuits) and 12 radio stations, including Rugby Radio, one of the largest in the world. A telegraph manager is responsible to ETE Headquarters for the telegraph and telex services, while telephone services are directly controlled by the Operations Branch, with London Telecommunications Region providing the operating staff. Unlike most other Post Office departments ETE operates under the salutary influence of competition from foreign telegraph companies and European administrations. The high level of transit telephone and telegraph traffic—a valuable invisible export—which continues to flow through London testifies to its success in meeting this competition and the part it plays in maintaining Britain's position in the field of international telecommunications. In this the Post Office owes much to the Government owned Cable and Wireless Limited whose world-wide network of submarine cables and radio stations serves Commonwealth and foreign countries.



Left: The international Telex switchboard as it was in 1955. It is still housed in the Central Telegraph Office but will soon find a new home in Fleet.

They have been ten spectacular years in which some of the most important developments in world communications have taken place

Mr. W. A. Wolverson, CB, now a Deputy Director General, was the first Director of the ETE.

YEARS OLD

Since its formation ETE has been involved in some of the most important developments in communication, for instance, in the first trans-Atlantic telephone cable opened in 1956 and CANTAT, the first section of the Commonwealth Cable, which was completed in 1961. ETE's successful operation of these two cables has contributed in large measure to the astonishing growth—by two-and-a-half times since 1952—of telephone traffic between Britain and the rest of the world.

Even more spectacular has been the expansion of the International Telex Service. Fifteen times more overseas telex calls are now being made between Britain and the rest of the world than ten years ago, and the number of overseas calls from this country, many dialled direct by subscribers, exceeds the number of inland calls.

Today, too, more than 200 international telegraph circuits are leased for private operation by

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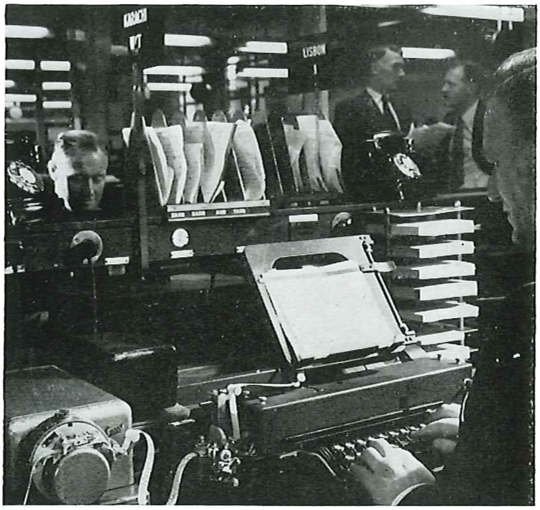

Right (above): Preparing a telegram in Electra House in 1960 for radio transmission to Karachi. Below: One of the newer Rugby Radio station buildings.

Sending a ticket by pneumatic tube to the Pneumatic Distribution Position at Continental Exchange.

business firms, airlines and the Press—an important but little-known service available to all the world's major cities which brings in a revenue of £1½ million a year. Electra House still handles 60,000 telegrams a day in spite of the impressive expansion of alternative forms of communication. Extensive mechanisation and decentralisation of the overseas public telegraph service is planned.

ETE's contribution to the transmission of news has also been considerable. Today, more than half a million Press telegrams a year pass through Electra House and in addition Press agencies in Britain rent 200 hours a day on ETE's radio transmitters for sending news messages direct to their customers all over the world. The BBC and the television companies rely on ETE for overseas sound links bringing news, commentaries and entertainment to London.

The successful way in which ETE has discharged its duties in its first ten years is all the more remarkable in that the staff who helped to form it came from so many diverse sources. They included telegraphists from the old CTO Cable Room, radio station engineers from the Engineering Department, administrative, traffic, executive and clerical officers from Post Office Headquarters and London Telecommunications Region and Electra House staff from LTR who had joined the Post Office from Cable and Wireless Ltd. two years earlier.

Looking ahead, ETE is likely to play an equally important and exciting part in the international telecommunications of the future. New telephone cables already planned include TAT 3—a second cable between Britain and the United States, extensions of the Commonwealth Cable to Australia and New Zealand—both to be ready in 1963—new cables to Denmark and Germany in 1964 and further extensions to the Commonwealth Cable to Singapore and Hong Kong about 12 months later. In the complex international negotiations which lead to agreement on the laying of these cables, ETE has been fully involved as, indeed, it is in all international agreements on telecommunications.

The next ten years will also see important advances in the handling of telephone traffic. Next year operators will be able to dial over the trans-Atlantic cables and in 1964 international subscriber dialling, for which plans are already far advanced, will begin.

Although satellite communications are still in their infancy ETE has already played a significant role in connecting telephone and telex calls and sending pictures and telegrams by way of Telstar and the Post Office Satellite Communication Station at Goonhilly. ETE will continue to make an important contribution to the development of satellite communications when other satellites are launched later this year.

N. V. G. Chapman

A MESSAGE FROM THE DIRECTOR

ON the tenth anniversary of ETE, its Director, Colonel Donald McMillan, sent a personal message to his staff in which he thanked them for their loyalty and goodwill and went on to say:

"During the past ten years we have seen many changes and laid the foundations for many more . . . That we have accomplished so much in ten years, often in the face of keen competition from abroad, is itself evidence of our success in welding ourselves, despite our diverse origins and backgrounds, into a successful team.

"The credit for much of this success must go to the staff associations whose contributions have always been constructive and stimulating and to the three Whitley Committees who exemplify the team work which alone can ensure success . . .

"I am confident that our next decade will be as successful and as exciting as the last and that we in ETE will have reason to be proud of the part we shall play in the development of world communications."

A telephone operator at the Continental Exchange.

OPERATOR SERVICES UNDER FULL AUTOMATION

By C. F. BEST

Strowger invented his mechanical switching device to replace the telephone operator, but even when mechanisation of the telephone service is complete operators will still be needed. The author discusses the three phases of mechanisation in Britain as they affect the provision and location of automanual switchboards of the future

THE telephone was only 14 years old when Almon B. Strowger, of Kansas City, invented the mechanical switching device which still bears his name. Strowger was not in the telephone business. He was not even an engineer. He was, in fact, an undertaker, and a not very successful one at that. The story goes that he had a feud with the telephonists of Kansas City, whom he suspected of contributing to his business difficulties by diverting calls to his competitors, and was determined to devise some apparatus which would replace the telephone operator!

Strowger's invention was slow in being taken up on any scale and although the first British patent was filed in 1891, another 21 years elapsed before the first automatic exchange was opened in Britain experimentally. It was not until the mid-1930s that the decision was taken to introduce automatic working generally.

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The change-over of the telephone system in the United Kingdom from manual to full automatic working falls into three phases. The first was designed to enable subscribers to dial their own calls up to the limit of the local call areas, which for this purpose was extended in 1936 to 15 miles chargeable distance. Call offices and coin-box renters were limited by the design of the coin-box to dialling only within the unit-fee radius. During this phase, covering 90 per cent of the traffic and planned for completion by 1945, the 4,000-odd manual exchanges were to disappear and the remaining operating force was to be concentrated at about 300 centres. This number was largely determined by the requirement that automatic exchanges should, in general, be within 15 miles of a manual switchboard for technical and tariff reasons. By 1945, some of these switchboards would have been quite small, possibly not more than two or three positions.

The three phases

This first phase was delayed by World War Two and was still only half complete when the second phase of mechanisation began. This was the development of dialling over trunk circuits and the introduction of automatic trunk exchanges to enable controlling operators to dial right through to the distant number, thus saving staff on incoming and through positions and reducing the time taken to set up a call. This phase was marked by the final abandonment of delay trunk working and the adoption of more liberal standards for the provision of junction and trunk circuits.

The second phase of mechanisation was overtaken by the third, which is the current development of Subscriber Trunk Dialling designed to enable subscribers to dial all their calls regardless of distance, accompanied by the introduction of a new type of coin-collecting box to give call-office users the same dialling facilities as ordinary subscribers. The impact of these developments on the automanual centre arrangements appears likely to differ somewhat from that of the earlier stages.

These stages, even now incomplete, were spread over a quarter of a century, during which time total traffic in the system grew threefold and the total operating force employed never ceased to expand. It seemed likely that the hard core of 300 ultimate automanual centres would never be reduced in number and might even increase through the opening of new trunk control centres and other measures to relieve larger automanual exchanges.

With the introduction of STD it seemed reasonable to plan for a reduction in the operating force and, since there were no longer any technical or tariff reasons why automanual switchboards should not be remotely situated from the automatic exchanges they were intended to serve, a further degree of concentration appeared to be possible. The problem was to determine which of the automanual centres around which the trunk network had been planned, were unlikely to justify retention under full STD. To those engaged in planning extensions or replacements of plant at such centres, an early answer to the problem was imperative.

Unknown factors

The answer, however, was not so easy to find because of the many unknown factors involved. Under fully-automatic conditions automanual centre operators have to deal with three main classes of traffic. First, they will connect trunk calls which customers prefer not to dial themselves and provide special services, such as transferred charge and credit card calls. Second, they will give assistance and advice to callers who have difficulty in dialling and deal with emergency calls. And third, they will deal with enquiries, including directory enquiries. The difficulty lies in forecasting what quantities of these types of traffic are likely to arise when subscribers have full dialling facilities.

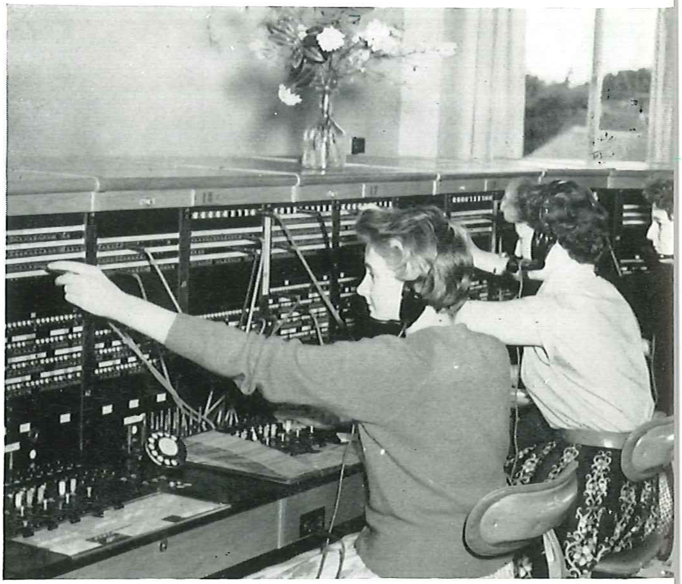
Until STD had been in operation for some months at exchanges representing a reasonable cross-section of telephone users, it was not possible to say what proportion of their calls subscribers would be prepared to dial themselves. Special services, such as personal and transferred charge calls, currently comprise about 15 per cent of all trunk calls and have a high work value. The STD facility for short cheap calls was expected to reduce the demand for such facilities, but by how much was anybody's guess.

Another unknown factor was the rate at which STD could be expected to extend throughout the system. Following its introduction at zone and group centre exchanges, further extension of STD can be expected to yield diminishing returns in operator savings and a point will ultimately be reached where the rate of withdrawal of traffic from manual control will be balanced by the growth of

the residual traffic together with enquiry and other traffic, the level of which is determined by the growth of the system as a whole. The point in time at which this balance occurs will determine the minimum requirements for automanual positions—a vital factor in any consideration of automanual centre concentration.

Various estimates of these unknown factors produced widely divergent views of the future levels of automanual traffic and the degree of concentration of automanual centres which would be practicable and desirable. These could range from one centre in each telephone manager's area to something not very different from the present arrangement. At the same time a number of technical problems having considerable influence on the location of automanual centres were unresolved. These factors undoubtedly created great difficulties for those responsible for acquiring sites and planning buildings to meet normal growth during the initial phase of STD.

However, as soon as we had acquired some experience of automanual traffic under STD conditions, and the technical problems had been solved, the picture became much clearer, and it was possible to lay down some general principles governing the location of automanual centres in the future.



A corner of the switchroom at the Weybridge Exchange.

An operator at the Monarch Telephone Exchange, London, goes through the procedure of dialling a distant number.

The Economics of Concentration

In fact, once the amounts of automanual traffic to be dealt with at the design period have been determined, it is now usually a comparatively simple matter to settle the problem of concentration. In essence, it is a question of balancing the net savings in operating staff and overheads which may result from closing down an automanual centre and merging the work with that of another, against the additional cost of the line plant needed to carry traffic to the distant operators.

Below a minimum size of switchboard, the costs of providing a 24-hour service are disproportionate to the traffic handled. As a general rule, the minimum size for a separate automanual centre has been taken as seven positions of all types. Above this level staff savings by concentration are small and largely independent of the amount of traffic to be concentrated.

On the other hand, the line costs of concentration are directly proportionate to the total amount of manually-handled traffic and the distance over which it is concentrated. These costs increase sharply where the distance requires the use of four-wire circuits. Since, under full STD conditions,

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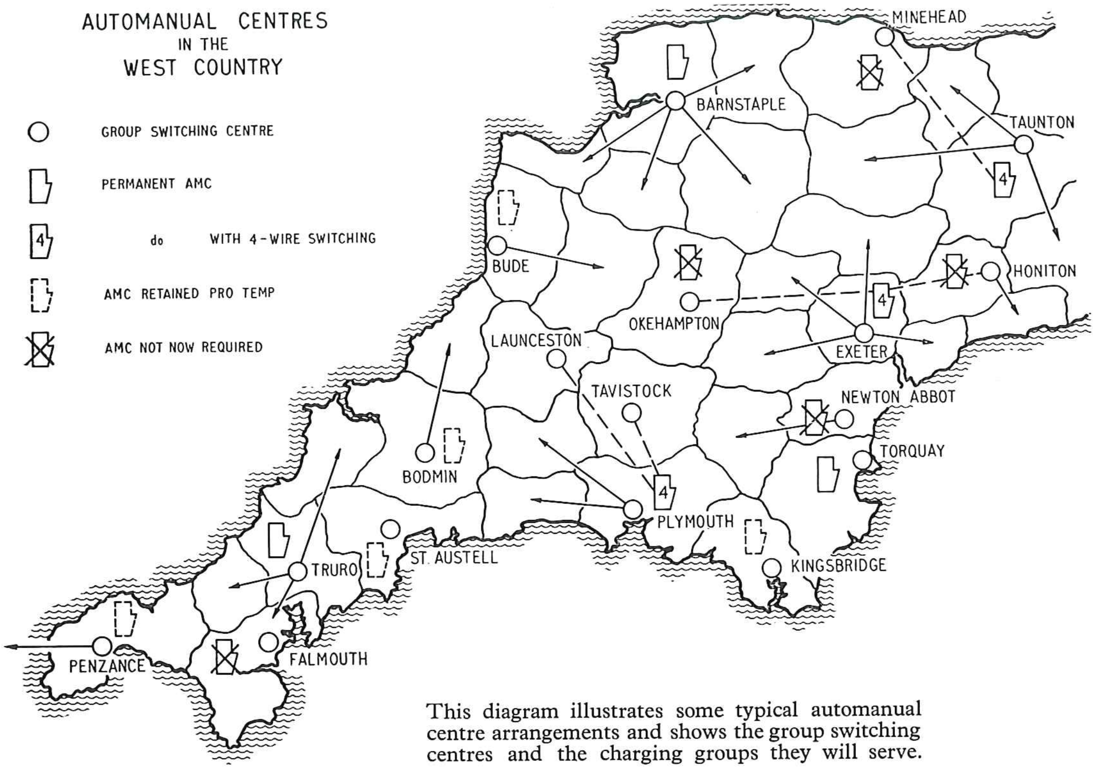

This diagram illustrates some typical automanual centre arrangements and shows the group switching centres and the charging groups they will serve.

the bulk of the automanual traffic will consist of local assistance and enquiry traffic, it makes little difference whether the direction of concentration is that of the main trunk traffic flow or not. It is thus possible to lay down as a rough guide that if, at any centre, the estimated minimum number of positions is more than 12 and the distance to the nearest alternative centre more than 12 cable miles, it is safe to assume that the retention of a local automanual board will be an economic proposition.

For automanual centres, where these simple guides give no clear indication either that the local board should be retained or that the manual services should be handled elsewhere it is necessary to compare possible alternative arrangements in terms of annual charges and capital costs.

It has been suggested that, in view of the preponderance of local assistance and enquiry traffic in the ultimate automanual board load, it might be possible to deal with this at a local enquiry centre, perhaps by means of ordinary telephones in office-type accommodation, the traffic requiring connection being handled remotely. Such a scheme might be feasible if enquiry traffic is confined to normal office hours, but with a 24-hour service such division of work would not be likely to produce substantial economies. The alternative of night concentration, besides requiring a margin of line plant in the evening busy hour, would involve maintaining duplicate subscribers' records and other complications. Although the possibilities of such arrangements have not been lost sight of, they do not show sufficient promise to offset the staffing and administrative difficulties which would undoubtedly arise.

Short-term expedients

Although it is normally comparatively simple to determine what is the correct long-term solution once sufficient experience of STD working has been gained to enable realistic estimates of minimum automanual position requirements to be made, some regard has to be paid in practice to the situation arising from earlier planning under

different assumptions. Many of the planned automanual centres which had been recently opened or were in course of building when the decision to introduce STD working was taken, were designed on the basis of continued operator control of all trunk and coin-box multi-fee traffic. Under the changed conditions such exchanges would have more than enough accommodation for all foreseeable requirements.

Where such a centre existed close to an exchange due for replacement and which had formerly been planned as an automanual centre, there were capital savings to be made by omitting the switchroom and welfare accommodation from the new building and concentrating the manual board traffic on to the centre where spare capacity existed. In other instances, where the equipment capacity was nearing exhaustion, such an expedient would save capital expenditure on a new site and building by allowing the switchroom to be used for extension of the automatic equipment. Expedients of this nature depend on other factors, such as the existence of spare cable capacity between the two centres. In this case, of course, the earlier exhaustion date of the cable would have to be taken into account.

Temporary automanual centres

Because of the earlier uncertainties of the future trend of automanual traffic it has been proposed, in some instances of conversion from manual to automatic working, to retain the old manual board in service to act as the automanual exchange. In other cases, although it may be clear that a local automanual centre will not be required in the long run, concentration at the outset may not be practicable. Although the retention of a manual switchboard as a temporary automanual centre is technically possible, the arrangement has certain engineering and operational disadvantages, of which the most significant is that pay-on-answer coin boxes cannot be served. An alternative arrangement, not subject to the same drawback, is to retain the old manual board for parenting UAXs only, the non-director exchange being served remotely by the permanent automanual centre.

Transmission considerations

Other considerations affecting the siting of automanual centres arise from the routing plan which is being adopted for STD. For charging purposes the country is divided into 639 groups. It was at one time thought that each group would need its own set of controlling register-translators to give the appropriate charges and that these would normally be located at an exchange within the charging group. Such an exchange would replace the trunk group centre in the transmission plan.

However, as planning proceeded, it was found to be more efficient, in many instances, if the control of STD traffic from two or more charging groups was concentrated at a single centre, usually their former trunk group centre, now known as the group switching centre (GSC). It was also found that, by suitable modification, electro-mechanical register-translators could provide three separate sets of charges. As this article went to press some 360 GSCs had been approved. The final number may exceed this slightly. On the other hand the total number of automanual centres may not greatly exceed 200, so that a large number of GSCs will need to have their automanual traffic dealt with at a board associated with some other GSC.

In these circumstances, an additional transmission loss is incurred on a call before it reaches the automanual board, possibly leading to unsatisfactory reception on a call set up over the maximum number of trunk links. To overcome this difficulty it will be necessary to install special four-wire switching equipment at automanual centres serving dependent GSCs to switch trunk calls other than those to places where a GSC can be reached over a single link from the automanual centre. The circuits from the dependent GSC also need to be four-wire. To avoid complicated operating procedure manually-controlled multi-link traffic from the home group must also be connected through the special equipment.

Manually-controlled calls which need four-wire switching will be routed over the transit network when this is available.

Choice of concentration centres

Economically it may be necessary to consider two or more alternative centres for concentration. Since it is desirable to keep to a minimum the number of centres which need to be equipped with the special four-wire switching facilities, they will best be located where they serve more than one group switching centre.

In addition to the straight cost comparison between alternative schemes, other considerations need to be taken into account which cannot readily be assessed in terms of money but which may sway

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the choice where the cost differences are not great. Present trunk group boundaries are aligned with the administrative boundaries of telephone areas, and charging groups frequently cross them. Where this occurs, customers in one telephone manager's area must address their enquiries and complaints to an automanual centre under the control of another telephone manager, which leads to administrative difficulties and means duplicating records.

So far, in the formation of numbering groups (to serve part of a charging group) and in the switching centre arrangements, it has been possible to minimise the effect of non-alignment and if boundary corrections are made they will affect only a few exchanges. It is possible, however, for an automanual centre concentration which appears feasible from a plant viewpoint to result in whole charge groups having their automanual traffic taken across administrative boundaries.

The alternative of transferring such groups to another telephone area is open to obvious objections, particularly from the customer's viewpoint, since it would involve his transfer to another telephone directory.

Recruitment of telephonists is particularly difficult in some places, notably larger towns, and this may affect the choice of location for an automanual centre. It is usually easier to recruit and retain good quality staff at the smaller centres, while the less frequent changes of personnel, together with the greater sense of belonging, produce better team working. Smaller exchanges tend to be associated with better and more personal service to the customer and to throw up fewer managerial problems than the larger exchanges. Other things being equal, considerations of staffing and service tend to favour the choice of the smaller centres for concentration purposes.

The final pattern

When the current review of automanual centres is complete it seems likely that about 200 places will be designated as permanent automanual centres. A few of the small boards which have been opened fairly recently may be allowed to live out their useful life. In some of the larger conurbations, notably London, more than one switchboard will be needed, but there will be some reduction in the large number of automanual exchanges now serving the director systems. The number and location of those destined to remain permanently will need to be considered in the light of any decentralisation of controlling register-translators.

Staffing and recruitment problems are especially difficult in central London, while the siting of buildings and plant there is very costly. This suggests that the reduction in the number of switchboards may be accompanied by a general move outwards. But against this must be set the fact that the lion's share of trunk traffic originates in the central districts which also contain the focal points of cables and radio links. The best use must clearly be made of existing plant and accommodation and planning for the immediate future must inevitably be based on expediency.

The Switchboard of the Future

With full STD, automanual switchboards will be fewer and smaller than they are today. The proportion of calls requiring connection to other subscribers will also be smaller and the work performed on switchboards will consist mainly of giving information and advice to customers and recording difficulties. A new design of all-purpose switchboard, with adequate space for records, is already being tried out and other possibilities are being considered.

The cord-type switchboard has had a long and useful life. It provides a simple and flexible means of setting up calls under a variety of conditions; allows maximum exploitation of trunk circuits; and permits the state of the traffic and conditions on outgoing routes to be readily observed. Moreover, it is considerably cheaper than the cordless boards so far designed.

In the course of trunk mechanisation and the transfer of trunk circuits from manual multiple to switch levels it has been found that the most economical arrangement is for operators to retain sufficient trunk circuits on the board to dispose of the great bulk of the residual manually-handled traffic, the trunks outgoing from switch levels being used as an alternative routing. This arrangement provides, as a useful by-product, the ability to dispose of urgent calls during congestion or breakdown.

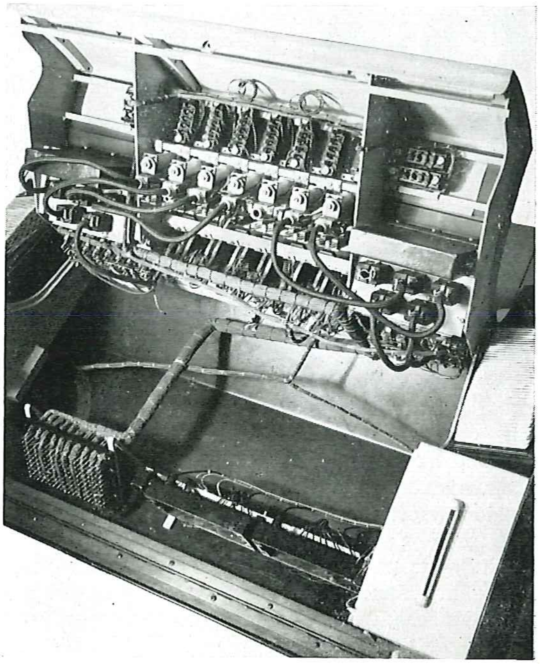
It is difficult, however, to envisage the survival of plugs and cords in the electronic age and many think that the switchboard of the future will be cordless. The method by which operators will gain access to the trunk network and the degree of preference they will have over subscribers have yet to be decided. There is also the question of whether

operators will continue to set up manually-controlled trunk calls by direct dialling or use national numbers, the routing of the call being controlled by a register-translator. Although the latter arrangement simplifies switchboard routing records, it would limit the assistance operators will be able to give to customers in difficulty. These, and other similar problems are at present being studied.

Automation of the local service is now 90 per cent completed and already one fifth of all trunk calls are being dialled by subscribers. In spite of this, the number of operators recently reached an all-time peak, increasing by 18 per cent since 1960. There are signs of a levelling off in staff numbers and the long-expected decline has now begun.

We have come a long way since Strowger's first crude attempts to eliminate the operator. Today's approach is more constructive, the operator is accepted as an essential complement to a fully-automatic system and great emphasis is placed on the personal service she gives. To carry out her task properly she must be given effective means of disposing of traffic rapidly and she should be located not too far distant from the customers she is required to assist. It has always been, and still is, the aim of automanual centre planning to achieve these ends while preserving the efficiency and profitability which have become the hall mark of the trunk service in the United Kingdom.

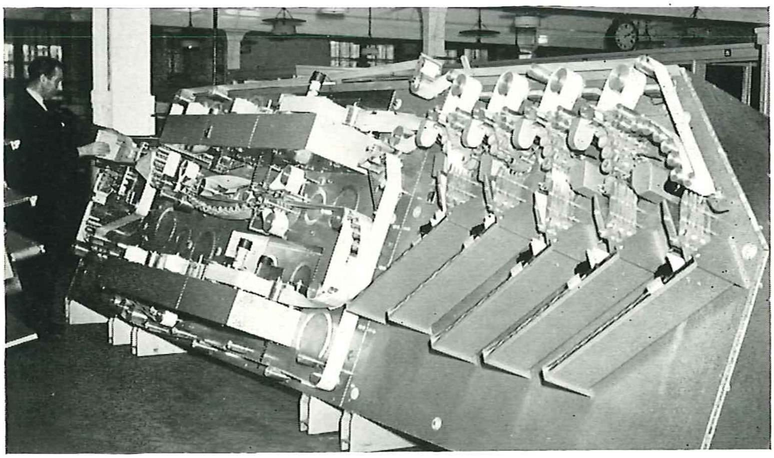
Top: The switchroom at the Stafford Cordless Exchange. The operator on the left has access to all telephone directories in the country. Below: The inside of a cordless board which has a capacity of seven cord circuits.



ELECTRONICS IN POSTAL MECHANISATION

By J. D. Andrews, A.M.I.E.E.

Electronic techniques are playing an increasingly important part in helping the Postal Services to speed the handling of mail



The automatic letter facing machine which arranges the letters the right way round, cancels the stamps on them and stacks them for sorting.

ONE of the Postal Services' biggest problems—and one which faces the postal administrations of every other country—is how to cope with the ever-increasing volume of mail it handles.

To help solve it the British Post Office has embarked on a large-scale scheme of mechanisation and encouraging results have already been achieved from field trials of prototype equipment, designed and built by the Engineering Department, in which electronic techniques play an important part.

In the separating of mail collected from pillar boxes, for instance, a process has been developed which automatically segregates it into four groups: items more than a quarter of an inch thick; letters bigger than five-and-a-half inches long or high; letters longer than seven inches; and standard size letters (which form about three quarters of the total mail) less than five-and-half by seven inches. In this process, electronic systems are used for detecting stoppages, thereby speeding up the work.

It is in the facing of standard-sized letter mail and in automatic letter sorting that electronic techniques have been largely applied, with highly successful results.

In the experimental letter facing process a stack of standard-sized envelopes—normally between two-and-three-quarters by four inches and five-and-a-half by seven inches—is taken from the automatic segregating equipment and fed end to end into a belt conveyor moving at five feet a second.

Each letter is examined for the position of its stamp in the first scanning area and the information obtained controls the divertor which sends the letter either straight on or through the twist section which turns it over so that all letters will have their stamps at the lower edges by the time they arrive at the second scanning position. Here, the stamps are more closely examined to separate those letters which have them at the leading edge of the envelope from those with stamps at the trailing edge. These are further sub-divided into fully paid items and those stamped at the deferred 2½d. rate. The second scanner passes signals to the divertors which ensure that each letter joins its appropriate stack. Normally, four stacks are used since, although letters can be twisted on their axis of travel they cannot be turned end to end. Unstamped items go into a fifth stack. The scanning sections are on two shelves and the conveyor belt is folded back on itself at the twist section to reduce the overall length of the machine.

The main functions of the electronic equipment of the Automatic Letter Facing Machine (ALF) are scanning, storage and analysis. Scanning involves determining the letter position by using light beams and photo-transistors and the examination for stamp position and value by using sensitive photo cells. Partial success has been achieved in experiments to locate stamps by detecting the low reflectivity of a stamp compared with the lighter colour of the envelope. This system, however, is likely to misinterpretation by dark marks on the envelopes and is also unsuitable for distinguishing between the deferred 2½d. rate and other stamps.

Several systems of marking stamps with some easily detected characteristic have been investigated. From 1957-60, for example, stamps sold in the Southampton area were marked with vertical graphite lines about one-sixteenth of an inch wide. The deferred rate stamps—then 2¼d.—were marked with one line and other values had two lines, one down each side. The lines were detected by contacts with a potential of 2,000 volts between them. As the letters passed across the contacts the graphite lines completed an electrical circuit, thus detecting the stamp.

Graphite lines have now been superseded by phosphor lines detected by photocells, a method which has proved extremely satisfactory. If a sufficient proportion of mail could be made to bear these phosphor lines no other method of stamp detection would be needed.

Signal analysis and storage, the remaining electronic functions required at the facing table, are carried out by conventional switching methods employing diodes, valves and cold-cathode triodes. The electronic equipment has been designed to be as nearly independent of valve characteristics as possible, thus producing a good reliability record. The equipment was made in 1957, when few transistors were available. Any future design would employ transistors with magnetic storage to obtain even more reliable, cheaper and smaller equipment.

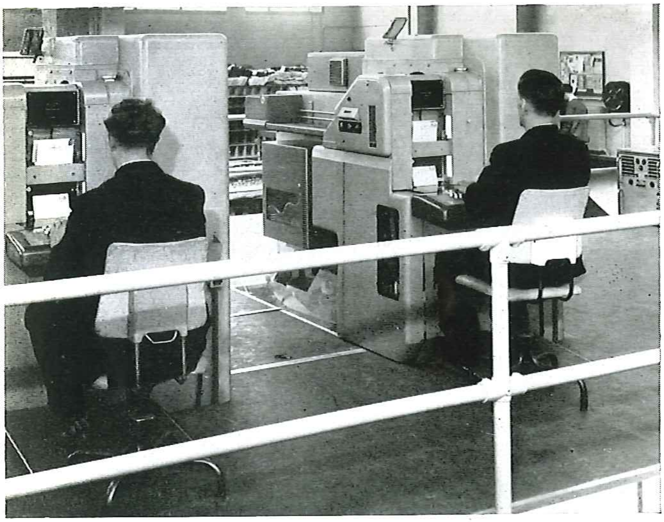
In postal mechanisation the operation lending itself to the largest application of electronic techniques is letter sorting. Normally, a postman holds a batch of envelopes, reads the addresses and places each envelope by hand in one or other of 48 boxes in front of him. If sorting to more than 48 boxes is needed, a second sorting stage must follow. More than one sorting stage may also be needed in the destination town. Sometimes, additional sorting takes place at an intermediate point.

Now, the Post Office is going ahead with an automatic letter sorting scheme, on trial at Luton, which aims at reducing the number of times a letter address has to be read and to eliminate manual handling. An operator sits at a machine which presents envelopes, one at a time, for him to

OVER

In this picture of the automatic letter sorting machine the operator's position is replaced by a reading head.

read. He extracts the information he needs from the addresses and types it on a keyboard, the envelope then being carried away to a printing unit which marks it with a row of phosphorescent code dots. These dots, up to a maximum of 14, are printed as directed by a translator which has already received signals from the operator's keyboard. Subsequent sorting can be carried out automatically by equipment which reads the code marks. The photocells which read the code marks pass the signals to a second translator which returns the correct routing instructions for each envelope.



At work at the coding desks in the Luton sorting Office.

The part played by electronics in this equipment is threefold: it controls the printing of the code marks, the reading of them and the translation of signals. Printing the marks presents no difficult electronic problem. The signals to be printed are stored by cold-cathode triodes until the envelopes reach the printing unit. Printing is carried out by transistor-controlled electro-magnets.

Reading the code marks—by passing the envelopes in front of a photo-cell which gives out a signal as each dot passes it—is more difficult.

The signals are distributed into a register controlled by a time base derived from the machine which has to give gating signals of the same phase and frequency as the signals on the envelope. This is achieved by generating a time base of eight times the required frequency, that is, as eight time bases staggered by one-eighth pitch. The appropriate time base is then chosen for each envelope so that it is within plus, or minus, one-sixteenth pitch of the optimum.

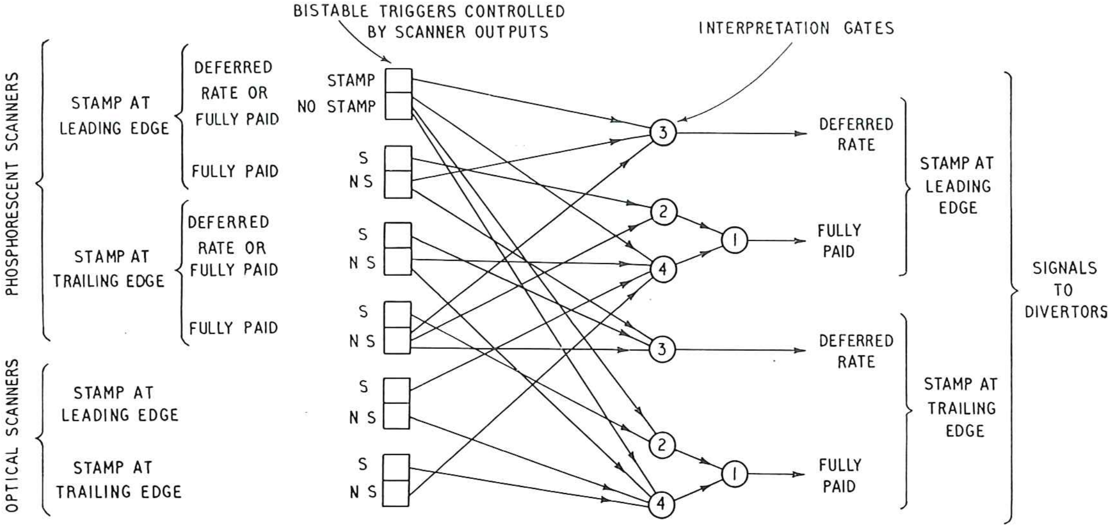
The two translators used in the printing and subsequent sorting stages are complex. The signals from the keyboard, for instance, are normally of five typewriter key depressions and more than 3,000 different codes have to be identified. The short time of two milliseconds needed to effect a translation means that the translator can be shared by many inputs and the present equipment, employing magnetic cores, transistors and diodes, can serve as many as 24 operators.

The full benefits of this automatic letter sorting scheme will appear only when mail code-marking is carried out in every town in the country. If this were done and every address given a national code, mail would be automatically sorted after being read by only one operator. An even more far-reaching scheme would relieve the operator of even this task and work on character recognition is being carried out by the Post Office to see if automatic reading of addresses can be incorporated into the mail sorting system. Reliable recognition of even printed characters is a tremendous problem but work must continue in this field if the Post Office is to reap the full reward of a wholly automatic sorting system.

The electronic systems have to fulfil two main requirements: they must perform the logical functions and they must be reliable.

In the facing machine the circuit has to interpret the signals seen by the scanners and to arrange for envelopes to be diverted into the correct stack, while triggers, which can be set to one of two conditions, indicate whether a stamp is seen on a particular envelope. Signals are taken from the triggers to "and gates" which require all input signals to be present before an output signal is given. The outputs of two pairs of the "and gates" are combined in "or gates." The signal interpretation performed by these gates operates on the basis that phosphorescent detection is more reliable than optical scanning.

The circuit performs the function required of a "2", "4" and "1" gate. The cathode of the double-triode assumes the potential of the more positive grid and, as the signal to be passed is more positive than the no-signal condition, the valve functions as an "or gate." The two groups of diodes form the



Part of the logical diagram of the autom ıtic letter facing machine.

two "and gates" and if the input to any diode is at the 50V potential to indicate "no signal" then the diode will hold the grid of the valve at 50V. Only when the inputs to all diodes in a group are at 150V can the grid of the valve rise to 150V and so pass the signals.

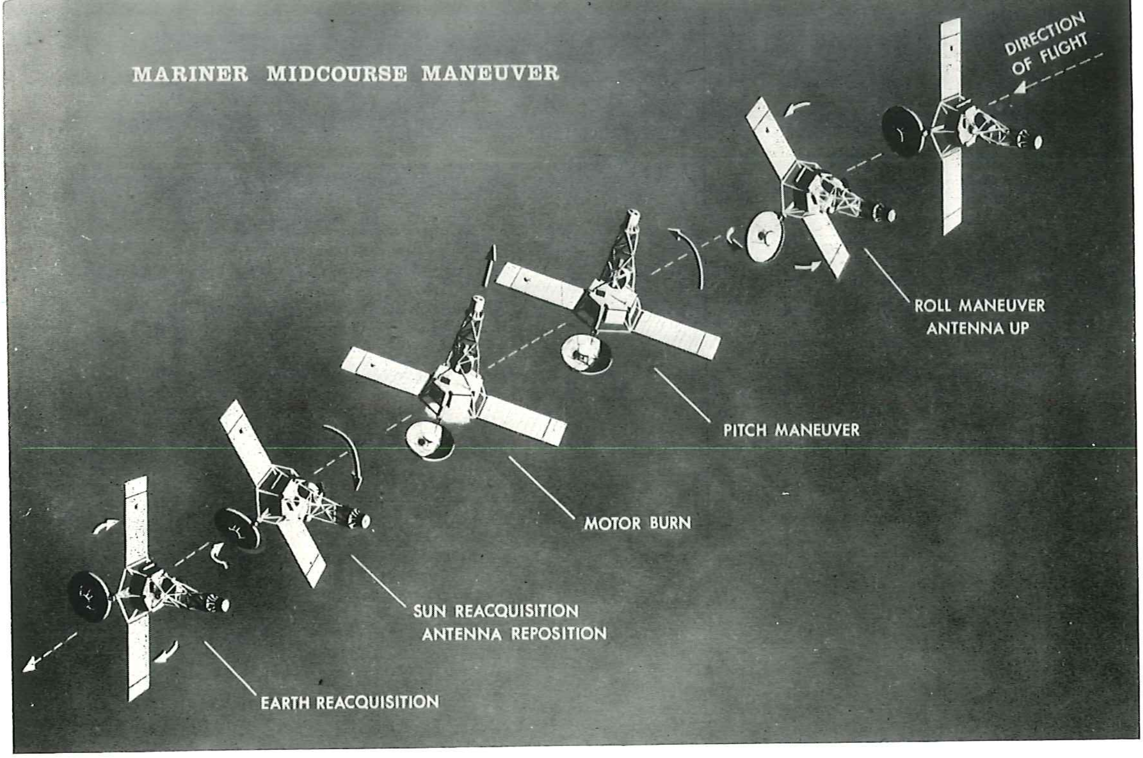
Proof of the reliability of this type of design is that only about ten valve replacements have been required in the past three-and-a-half years, during which time the 200 valves in the facing machine have been in operation for 10,000 hours. Future equipment for postal mechanisation will not use valves in the logical circuits. In the letter-sorting project, designed in 1959-60, transistors with magnetic cores and cold-cathode triodes are used which give even greater reliability.

The translator in the letter sorting equipment can give six variations of the output translation and must be able to be switched from one variation to another for successive two-millisecond translation cycles. DC signalling is used since the switch on the operator's machine may be remote from the translator. The operator's switch sends a signal to one of his six "and gates" and the other signal needed by all these gates is a pulse delivered to each operator's equipment at the appropriate time. When this is received, a signal is sent to the common equipment to indicate which sorting plan is needed for that particular operator.

The circuit performs this function in the following manner. When the base connection of one of tne transistors is held at a potential more positive than that of the emitter, current cannot flow in the collector emitter circuit. When the base is made negative in relation to the emitter, however, current can flow. Of the six transistors connected to the switch only one is linked to the negative supply, the other five being held off by a positive potential at their base connections. None of the transistors can conduct, however, until the upper one, which is in series with them all, is made to conduct. This transistor is normally held "off" with a positive potential at its base. A timing signal allows it to conduct for about ten microseconds, thus permitting one of the six parallel transistors to conduct, giving a ten micro-second signal on the output wire appropriate to the position of the remote switch.

This circuit is both economical and reliable. The number of components, the space used and the power requirements are all small. The reliability of transistors used in this way is proved by the performance of the translators which contain about 3,000 transistors, none of which has failed in more than 10,000 operating hours.

Electronics are playing an important part in the plan to mechanise so far as possible the work of the postal services but this does not mean that they can provide the answers to all the problems which have to be overcome before postal mechanisation is complete. As this year's Post Office Report pointed out: "Letter sorting machines are both expensive and limited by the speed at which operators can think. Ways must be found of freeing them from this limitation. . . . Before such equipment can be brought into wide and regular use its economic worthwhileness must be proved and even after that considerable planning and development would remain to be done."



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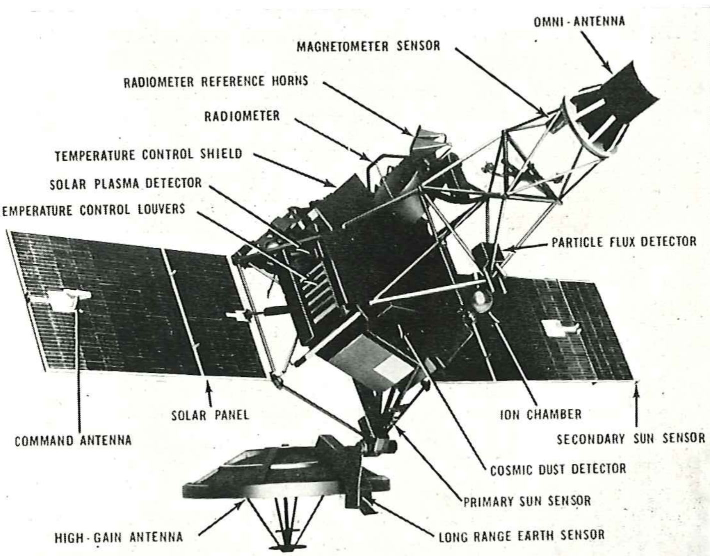

Mariner II, the first in a series of space craft designed for interplanetary exploration.

THE British Post Office is providing a vital link in the chain of communications as the United States space craft, Mariner II, hurtles on its 182 million mile journey towards Venus.

Mariner II is being tracked by Jodrell Bank and a tracking station in Pretoria, South Africa, and the signals received from the space craft by both these places are being sent to the National Aeronautical and Space Administration (NASA) room in Electra House, London, for onward transmission over the TAT 1 submarine cable to the Goddard Space Flight Centre in the United States, which is also being fed with information obtained by other American tracking stations. The special switching, sequencing, monitorial and signal regenerating equipment at Electra House is controlled by NASA but was installed and is operated and maintained by Post Office staff.

Mariner II, which weighs 447 lbs, was launched from Cape Canaveral on 27 August to obtain information about the planet Venus, which is covered by thick clouds of carbon dioxide and hydrogen. Its instruments will measure the magnetic forces

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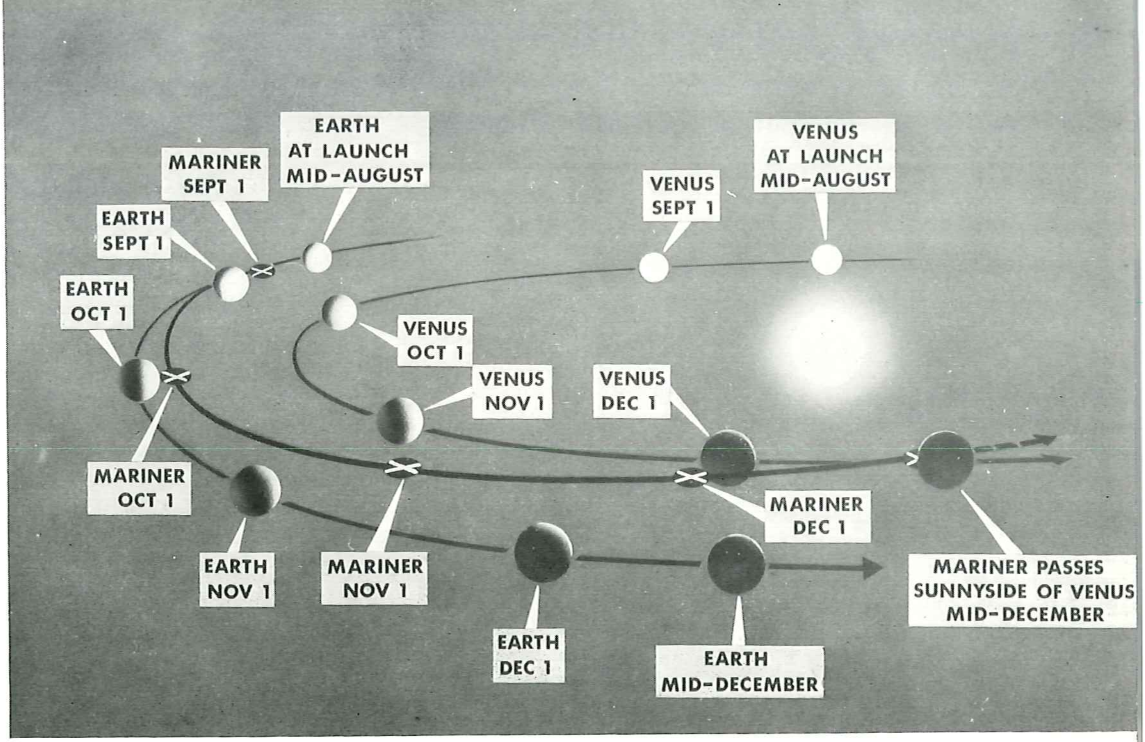
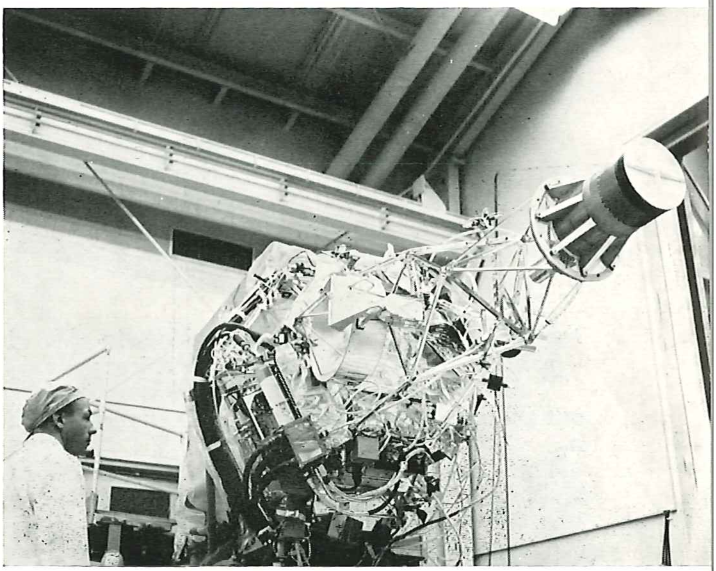


JOURNEY TO VENUS

around Venus, the planet's temperature, infra-red radiation, the number of meteoric particles and electrically charged particles and obtain information on other phenomena which are expected to be of use in space communications.

Soon after launching, Mariner II suffered a 50-second period of excessive roll which put it 233,000 miles off course. But this was corrected on 5 September when scientists at the Goldstone tracking station, California, sent a radio signal to the space craft, then one-and-a-half million miles from the earth, which fired a rocket on Mariner II and put it back on a course which will take it 9,000 miles from Venus—1,000 miles closer than originally planned.

Mariner II is not intended to hit Venus, which might contaminate the planet's surface, but to orbit the planet at about 10,000 miles. It will be nearest to Venus on 14 December when the planet is 36 million miles away from the earth and will have only 30 minutes in which to send back its information. After this, Mariner II will go into endless orbit round the sun.



Mariner II undergoes one of its many tests before being launched from Cape Canaveral.

This lithograph of about 1850 shows (left) the original GPO (where Armour House now stands), the Bull and Mouth Inn (right) on the site of the present Headquarters Building and the buildings which were pulled down to make way for the CTO.
—Reproduced by courtesy of the Guildhall Library.

FAREWELL TO THE CTO

Soon to be demolished, the old Central Telegraph Office in the shadow of St. Paul's has a fascinating story to tell

By S. W. DABBS

Illustrations: E. A. Oldman

THE Central Telegraph Office in St. Martin's-le-Grand is doomed. Next year the last of its occupants will have moved out and the demolition squads will be moving in.

The CTO building, originally known as GPO West, was erected in 1874—four years after the Post Office had taken over the public telegraph system and shortly after Mr. Gladstone had succeeded Mr. Disraeli as Prime Minister. In the world of telecommunications 1874 was a notable year, marked by the birth of Marconi and the invention by Jean Baudot of what we should now call a time-division multiplex system of telegraphy, which was to become of tremendous importance to telegraphs.

There was a very real connection between Mr. Gladstone and the CTO for, following his famous Home Rule speech in 1896, one-and-a-half-million words were handed in at the CTO for transmission to the Press.

The story of the CTO building is almost the story of the British telegraph service and even more than that. The CTO once housed Post Office

Headquarters and the staff of the Engineer-in-Chief. Within the ranks of the telegraph staff arose the idea of Benenden Sanatorium, later to grow into an institution larger and finer than its originators dreamed. The CTO staff still keep this connection with Benenden very much alive by sending every patient a Christmas gift and the CTO Welfare Officer regularly visits patients from distant parts of the country.

The CTO has alternately grown and shrunk in a bewildering manner. Starting life with four storeys, it later grew to five, then was burned down by incendiary bombs to no storeys at all—only a shell—and then temporarily rebuilt to two storeys, later expanded to three. The present building is temporary in the sense often associated with Government buildings, but by the time it is demolished it will have been occupied for well over 20 years! Parts of the building show honourable scars from bombs dropped during World War Two which blew out most of its windows at least twice.

The CTO was never designed to be a telegraph office. A writer in the *Telephone and Telegraph Journal* nearly 40 years ago said: "The building was not originally designed for telegraph work, but has been acquired and adapted, little by little, over a period of fifty years." When the telegraph service—then the only means of rapid communication in Britain—was taken over by the Post Office in 1870, the principal telegraph office was housed in premises in Telegraph Street. In 1874 the telegraph terminal was moved to the new building in St. Martin's-le-Grand to make room for the very rapid expansion then taking place. This expansion brought with it many problems.

The first major problem was the slowness of the hand-operated Morse key which sent at the rate of about 30 words a minute and severely limited the number of messages sent over one line in a day. One of the first solutions was the Wheatstone automatic transmitter and receiver which initially handled 200 words a minute and was later developed to handle 600. In 1874 the CTO was working 31 Wheatstone circuits to the principal provincial towns, but most of the CTO circuits were equipped with Morse key and sounder. Short lines were worked single-current (off and on); longer lines double current (push and pull) and for all but the shortest lines methods were devised for sending duplex (both ways at once) or quadruplex (two channels up and two channels down, all capable of working simultaneously). All these systems produced their own problems. The Wheatstone transmitter, for example, which took the output from several operators (on punched tape) needed careful organisation to keep the machine and the operators fully occupied, while quadruplex and similar networks were troublesome to adjust, being upset by effect of the weather on the overhead lines.

The CTO blazes after being hit by a German bomb in 1917. But the damage was negligible compared with that sustained in World War Two. This picture was taken from Cheapside.

Scores of telegraph systems were tried out at the CTO, some to be abandoned quickly, others to become part of the telegraph evolution pattern. The ABC instruments were cheap and reliable, but far too slow for any but the lightest-loaded circuits. The Morse key gave a good many people telegraphists' cramp and attempts to produce a semi-automatic key did not find favour with all the staff. The Telewriter, a novel machine which produced a facsimile of the original message, was not adopted on any scale for commercial working. The Buckingham printer translated Morse signals from a Wheatstone receiver into printed characters—a step in the right direction—but if an operator made an error the entire message had to be re-sent. The Hughes type-printing telegraph, which produced roman letters on a tape at the receiving end, had its day, but it had to be fed with five-unit code

OVER

An operator at work on a Morse key and sound in 1934. This system was not popular because it gave many operators cramp.

Teleprinter manual switchboards were installed in the CTO in the early 1940s. This system, adopted to save manpower, led to teleprinter automatic switching (TAS) now standard in Britain.

CTO *(Continued)*

signals by a highly skilled operator and thus did only half the job of a modern teleprinter.

The CTO also tried noiseless-typewriter reception on Morse circuits but the sending operator was not able to send fast enough to keep the receiving operator working at a reasonable speed. The Baudot, working up to six channels each way on one circuit, up to 40 words a minute per channel, became an important system and was widely adopted on the long circuits. It finally went out, however, because it had to be fed, like the Hughes machine, with five-unit code signals produced by a highly skilled operator. It was not worked from a simple typewriter keyboard.

The Creed system, which received ordinary Morse signals on a perforated tape and then, as a separate operation, translated the tape into roman characters, was ingenious but untidy in conception and did not command popularity. The system finally adopted universally was the teleprinter, which started and ended with letters and worked at ordinary typing speed so that the one operator occupied one channel. By the time teleprinters were developed, overhead telegraph lines had been replaced by underground lines which, in turn, were replaced by the much cheaper VF telegraph channels.

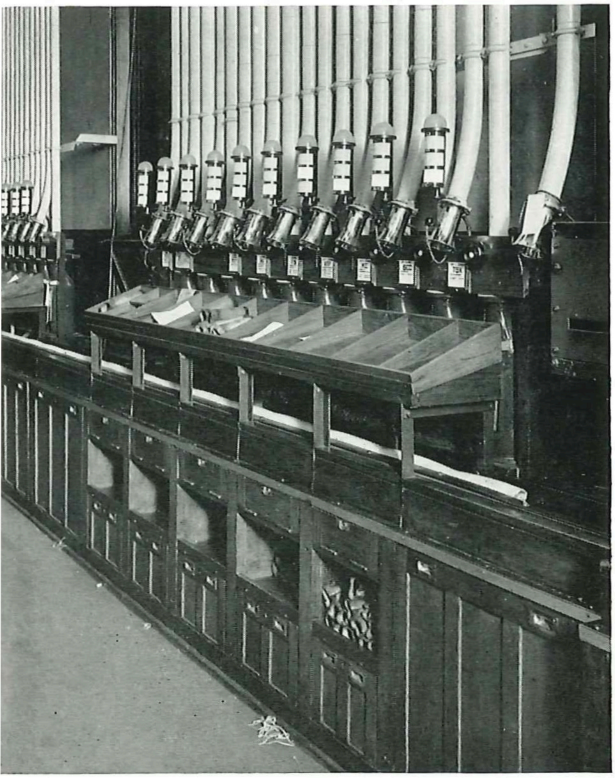
In the CTO's early days the number of Morse circuits connected to places only a few miles from London grew rapidly. By 1902, over a thousand small offices were served from the CTO (on a point-to-point basis) and there was a tremendous amount of through traffic. Every through message —some 26,000 a day—had to be taken from the incoming circuit and re-sent over the proper outgoing circuit. The Engineer-in-Chief, who was called in to advise on this problem, designed a switching system which enabled any two of these circuits to be connected, so that the message was sent only once, right through to the terminal office. This switching system did a most useful job and went out of service only when the growth of the telephone system took away the short-distance traffic from telegraphs.

The first teleprinters were worked on a point-to-point basis, each machine being permanently connected to a given office. In about 1943 a nation-wide teleprinter switching scheme, using manual

switchboards, was introduced, working roughly on the same principle as the Metropolitan Switch installed 40 years earlier. This switching scheme enabled a connection to be set up to any desired telegraph office for the purpose of sending one (or more) messages, after which the connection was broken down. This system removed from the CTO an enormous volume of through traffic and considerably reduced its size and importance. A few years later the manual switching scheme was replaced by automatic switching doing the same job but cutting out manual switchboards. This is the system currently in use.

Originally, all the apparatus associated with any circuit, such as resistence-boxes, relays and galvanometers, was mounted at the operating table, with the result that the instrument rooms (or galleries) looked untidy. With the coming of the teleprinter, the relays were taken off the operating positions and mounted on apparatus racks, and finally removed from the galleries, leaving only the teleprinters at the operating positions.

By the 1920's the CTO was full of telegraph circuits, distributed over the building as follows: Metropolitan and Outer London, 4th floor; Provincial, 3rd floor; Continental and Imperial Cable, 2nd floor; City and Registered address traffic, Ground floor.



Pneumatic tube terminals at the CTO main circulation point in 1935. The three lamps for each tube showed whether it was in use for an outgoing or incoming call or disengaged.

". . . Messages were conveyed from floor to floor . . ."

Messages had to be conveyed from circuit to circuit and from floor to floor, and since some 140,000 messages a day passed through the office in the summer months the mere handling of them presented a serious problem. Collection by hand inevitably introduced delay and any attempt to reduce it by more frequent collection meant a great deal of walking about. The Western Union Company in New York tried to solve the problem by using a mechanical system for collection from the main points, supplemented by young girls on roller skates for subsidiary collection and distribution!

At the CTO, the Engineering Department was again called in and in 1930 came to the conclusion that conveyor belts would supply the answer. A three-band model conveyor-belt system was constructed from Meccano parts to demonstrate the effectiveness of the system and a full-size system working on identical principles was put into the East Gallery of the CTO. But, like any other innovation, conveyor-belts brought their own problems. If an open or flat belt moved faster than 200 feet a minute the telegram forms floated off. The motion of the belts also caused them to become charged with static electricity so that the forms

OVER

Above: The CTO Phonogram Room as it was in 1937. Both inland and overseas phonograms were dealt with on this suite. Below: Phonogram positions at the new Central Telegraph Office in the Fleet Building 1962.

CTO (*Continued*)

failed to drop off at the proper places. (A gold-leaf electroscope connected to the belts gave warning that weather favourable for electrification was approaching). However, cures were found for these difficulties. By gripping the forms between two belts the speed could be raised to suit all ordinary needs and by treating the belts with glycerine and fitting special neutralising rollers at strategic points the electrostatic trouble was overcome.

Conveyor belts continued to serve the CTO faithfully for the next 30 years. They were not cheap to install but must have saved their cost many times over as well as making a major contribution to the efficiency of the office. In 1935 the daily number of telegram journeys within the CTO averaged 205,000. Similar conveyor-belt systems were also installed at the larger provincial telegraph offices.

Another prominent feature of the CTO was the extensive pneumatic-tube system used to carry messages not only from point-to-point within the building but also to and from other buildings in

central London. The street tube system in London was the largest in the country and in its heyday served 67 offices. The tubes went as far afield as the House of Commons and the Western District Office (over two miles) and for the longest, transit time could be up to 15 minutes. The usual rate of travel was about 30 feet per second.

Tubes date back a long way. As early as 1853 there was a telegraph tube between the Stock Exchange and a Telegraph Company's office. In 1870 the Post Office took over tubes totalling two-and-a-half miles from the private telegraph companies and by 1920 there were well over 100 miles of tubes in use in London and the provinces. The tubes were made of lead, mostly two-and-a-half inches in diameter, and lasted a very long time. Some must have been in use for over 80 years and even then were abandoned for policy reasons and not because they had ceased to function. They worked by pressure or vacuum, up to 12 lbs. per square inch pressure, or up to six-and-a-half lbs. per square inch of vacuum for the street tubes, and about half a lb. vacuum for the "house" or internal tubes. Much ingenuity was expended on the design of tube terminals, which automatically transferred a carrier from a street tube to a house tube without spoiling the pressure or vacuum for other carriers.

The first picture transmissions were made from the old CTO. Here, a picture is fitted to the transmitter drum in 1937.

At one time over 10,000 telegrams a day were conveyed by tube to and from the CTO. While they were doubtless expensive to install the tubes contributed much to the efficiency of the telegraph service, being remarkably free from faults and needing little maintenance. The CTO tubes finally closed down in April, 1962.

In 1898 the CTO power plant consisted of 25,000 primary cells, most of the Daniell type. Presumably every major circuit had its own separate power supply and keeping all these cells in prime condition must have been a trying job. The primary batteries were in due course replaced by secondary cells similar to those used in telephone exchanges, while the systems in use were made to operate on a common-battery basis. One interesting source of electricity was a thermopile made from galena and iron, which generated electricity directly from a gas jet. It is said to have deteriorated because, in the interests of economy, the gas jet was turned off every night and the thermopile could not stand being alternately heated and cooled.

In 1935, the 25th Jubilee year of King George V, a fine new assembly, lecture, and dance hall, known as the George V Hall, was opened on the ground floor of the CTO, occupying space no longer required for telegraphs. This hall, the fruition of an idea sponsored by the Postmaster General, Sir Kingsley Wood, was the first of its kind in central London and it met a need that had been sorely felt for many years. Alas, when the CTO was burned out in 1940, the George V Hall was destroyed and the Post Office remained without a satisfactory assembly hall in central London for the next 21 years until Fleet Building opened.

Stories connected with the CTO building come echoing back from the past. Friction between various sections of the staff was once so marked that orders were given to open windows for the first ten minutes in every hour, summer and winter, and then shut them tight. Twice every hour there was

OVER

"... fresh air fiends and fug addicts..."

The Metropolitan Gallery in Telegraph Street, 1871.

CTO *(continued)*

a concerted rush, once by the fresh-air fiends, and once by the fug addicts. The ideal solution was never found. One elderly woman was so sensitive to draughts that she wore a tight-fitting cockade-type hat throughout the day. Another, who amended rule books, insisted on doing her work in the telephone "silence" cabinet, to escape draughts.

In contrast to the generally strict atmosphere in the office, the staff made a practice of eating at the circuits. Every telegraphist was officially supplied with two thick slices of bread and butter and a cup of tea, early morning and mid-afternoon. Supervising staff were more genteel. They had three slices of thin bread-and-butter and a cup with saucer. But they were not allowed to sit down. Men supervisors with healthy appetites occasionally exchanged their three thin slices for a telegraphist's two thick ones.

Telegraphists were obviously convinced that their efficiency was greatly improved by drinking tea, for large quantities were consumed. The Controller got really worried about the growth of this habit and in 1906 he wrote: "My attention is drawn to the fact that the practice of partaking of tea, milk, etc., during all hours of the day is largely on the increase, and has indeed already attained such proportions as make it necessary to impose some restriction, in the interests of the staff, as well as of the Department. The Medical Officer, whose opinion I have obtained, regards the habit of frequent tea drinking between meals as very prejudicial to health, and on these grounds alone it is desirable that the staff should exercise some restraint."

At one time, every member of the CTO night staff had his or her own jug, to be filled with tea or coffee or beer, according to taste, for supper.

The attitude of supervising officers towards the staff was stiff and formal. Once a day the Controller would sweep majestically through the galleries in a frockcoat, carrying his top-hat in his hand and attended by half-a-dozen senior officials. The older women wore black silk aprons and for the younger women sleeveless dresses were considered indecent.

But, in spite of their stiffness and formality, Controllers did not always get their own way. When anybody popular left the service all the telegraphists at a given signal on the last day would seize a round ruler or anything else that would serve and bang the slip bin. The noise was terrific. One Controller issued strict instructions that this practice must stop, but tradition was too strong for him and his orders were ignored.

A telegraphist who put in an application for a week's special leave to get married drew forth this retort from the Controller: "The more I see of the CTO and of the London Departments of the Post Office generally, the more I am filled with amazement at the audacious demands on the public purse for leave of absence and other privileges." However, he gave the man three days, which wasn't ungenerous.

Not long after the CTO was built, the telephone had begun to make itself felt. Its power as a rival to the telegraph service was doubtless recognised at an early stage, for there is a trace of jealousy in a CTO instruction of 1884 which read: "Telephone exchange addresses. These are not to be acted upon, not being registered with the Department, and such telegrams should be treated as insufficiently addressed."

The first public line to Paris was installed in the CTO, and a call-office service to Paris was provided at Threadneedle Street Branch Office mainly for the use of the Stock Exchange. Customers were allowed to use the line only for limited periods and had to observe strict turn. In 1891 the Controller decided that if two clerks came along from the same firm, the second could not have a turn if anyone else was waiting. In 1906, there was a minor upset because the Trunk Telephone Exchange Manager had called at the Stock Exchange telegraph office without obtaining the CTO Controller's permission. By 1907, the telephone system was becoming well established but it was still on a small scale, as witness this notice exhibited in the CTO call-office: "Supplementary Telephone Directory. New subscribers' numbers are published every Monday in the Westminster Gazette."

The idea of handing in telegrams by telephone was a little slow in catching on and taking the messages down could be trying to the staff. A writer in the *T & T Journal* in 1926 recorded: "Accustomed to the deferential attitude exacted of all those surrounding them, these people expect to be greeted across the telephone in tones which indicate the conscious humility of the operator. To these the 'voice with a smile' is an offence, the raised inflection is an outrage, and the demand for a 'No, sir' and 'Yes, madam' reply to every word of a repetition and every question asked, is an absolute fact."

The staff at the CTO have always formed a very closely-knit team. In its heyday, the building housed some 5,000, a large enough unit to permit the development of social activities of all kinds. The operatic society produced some very successful Gilbert and Sullivan comic operas. The CTO retired colleagues' associations are still flourishing concerns with large memberships and the annual dinner of the CTO Veterans is an impressive gathering. The CENTELS, once the main sports and cultural association, has unfortunately had to close down but many social activities still continue. The fine traditions of the staff will be kept alive in the new Fleet Building, for they are more permanent than bricks and mortar.

* Material for this article was obtained from many sources, in particular *Short History of the Telegraph*, by H. Sellars; *T & T Journal*—G. T. Archibald and others; *PO Green Papers*, 9 and 46, by E. C. Baker, J. E. M. McGregor and D. P. Gilbert; and *Telegraph Practice*, by J. Lee, to whom the author makes acknowledgment.

Telecommunications Statistics

	Quarter ended 30 *June*, 1962	*Quarter ended* 31 *March*, 1962	*Quarter ended* 30 *June*, 1961
Telegraph Service			
Inland telegrams (excluding Press and Railway) ...	2,895,000	2,918,000	3,056,000
Greetings telegrams	714,000	709,000	757,000
Overseas telegrams:			
Originating U.K. messages	1,570,000	1,627,000	1,611,000
Terminating U.K. messages	1,583,000	1,617,000	1,589,000
Transit messages	1,320,000	1,361,000	1 326,000
Telephone Service			
Inland			
Gross demand	117,000	127,000	149,000
Connections supplied	102,000	108,000	129,000
Outstanding applications	146,000	147,000	174,000
Total working connections	5,241,000	5,210,000	5,104,000
Shared service connections	1,117,000	1,125,000	1,146,000
Total inland trunk calls	129,034,000	123,603,000	114,100,000
Cheap rate trunk calls	30,334,000	26,604,000	27,633,000
Overseas			
European: Outward	953,000	902,000	843,000
Inward	888,000	859,000	803,000
Transit	9,000	7,000	4,000
Extra-European: Outward	88,000	82,000	75,000
Inward	105,000	100,000	85,000
Transit	15,000	13,000	19,000
Telex Service			
Inland			
Total working lines	9,000	9,000	7,000
Metered units	23,572,000	22,714,000†	17,197,000
Manual calls from automatic exchanges (Assistance and Multelex)	2,600	2,600	2,000
Calls to Irish Republic	20,000	20,000	19,000†
Overseas			
Originating (U.K. and Irish Republic) ...	1,251,000	1,256,000	912,000
Transit	13,000	14,000	22,000

Figures are to the nearest thousand. † Amended figure.
Correction. In the Autumn issue the figures shown against Overseas Telex—Terminating (U.K. and Irish Republic) were for Transit calls.

SPEEDING TELEPHONE SERVICE OBSERVATIONS

By F. A. WYETH

and C. L. DANN

An experiment in LTR with a new punched-card device and a high-speed computer which processes details of telephone service observations has been so successful that the scheme is to be extended

THE Post Office has long been trying to find a way to speed the work involved in processing information about telephone calls so that management can have a clear picture of the quality of the service.

Now, thanks to mechanisation, it may have found the answer. Since February of this year the Long Distance Area of the London Telecommunications Region have been recording their findings on a new punched-card device—called a Port-a-Punch—and the data has then been analysed and summarised at high speed in a computer. The trial has been so successful that the scheme may be extended to other centres. The Post Office is the first organisation in Europe to use the device.

Quality control of the telephone service takes the form of checking on the setting up of actual calls and in the Post Office this work is at present carried out by trained supervisors who record the progress of individual calls in considerable detail. These observations are taken on local automatic and manual exchange calls, auto-manual switchboard calls, on calls passing through trunk automatic exchanges and on subscriber dialled trunk calls.

Supervisors record details on their Port-a-Punches.

Recording is carried out at observation desks where the various stages reached during the setting up of telephone calls—including such items as the digits dialled—are indicated by lights on a display panel. The details of the calls are later summarised (usually for a month at a time) in the Area Traffic Office. A synopsis of the results is also sent to Regional and Post Office Headquarters where it forms the basis of national summaries. The number of calls checked is sufficient to ensure that the results reflect a true picture of the quality of service being given to the customer. At the same time it is

detailed enough to enable any aspect of the service to be studied at any time. By comparing the results for one exchange over a period an indication is given of the overall improvement or worsening of the service and of the effect of any remedial action that has been taken.

If the results are to be of real value to management, they must be readily available. But the clerical processes of summarisation and calculation are often tedious and boring and it has been difficult to obtain sufficient staff in London to ensure that the work is completed in the minimum time. With the growth of Subscriber Trunk Dialling more observations are being taken, with a consequent worsening of the position, and, towards the end of 1961, it was decided to investigate the possible use of machines to summarise individual observations.

The conversion of recorded information to a form which can be readily processed by machine is normally one of the most costly items in any mechanisation scheme and preliminary investigations showed that the cost of converting the dockets to a form suitable for machine processing was likely to equal the possible savings from mechanisation. However, in January, 1962, details became available of an American innovation called a Port-a-Punch which could be used for direct data recording on punched cards. This device appeared worthy of trial and following consultations between the Inland Telecommunications Department and the London Telecommunications Region it was decided that this should take place in the Long Distance Area.

The Port-a-Punch consists of a punching board, a clear plastic template perforated with guide holes and a punching instrument very similar to a mechanical pencil. Special cards pre-scored around each punching position are used and information is registered on them by pushing out the pre-scored chips. The maximum of 40 alternate pre-scored columns allows the printing of information, free from punching obliteration, in the intervening unscored columns, thus making visual interpretation of the recorded data speedy and straightforward for people with little or no punched card experience—a considerable advantage when dealing with immediate inquiries.

Under the new mechanised system once the cards for a particular exchange have been prepared they are edited and sorted by conventional punched-card machines into the order required for the final reports. The analysis, calculation and printing are then carried out at high speed by an electronic computer. Previously the preparation of reports involved a number of intermediate summaries and a lot of tedious hand-sorting.

Under mechanisation the sorting processes are carried out automatically. The cards contain, among other information, details of the digits dialled, which enables the cards to be sorted

OVER

An automatic, high-speed machine of the type installed by the Post Office for sorting the telephone observation cards.

Speeding the System (*Continued*)

into dialling code order. Reports are normally required, however, by routes alphabetically arranged within type of signalling. This arrangement of the cards is achieved mechanically by introducing pre-punched master cards, one for each route, as a first step in the dialling code sort. The cards emerge from this initial sorting in dialling code order, a master card leading each group of the same code.

In addition to dialling code, name of route for print-out purposes and the appropriate charge rate for the route, each master card carries a numeric code (known as the route/type code) allotted in such a way that, when arranged in ascending sequence of route/type code numbers, the master cards fall into report order.

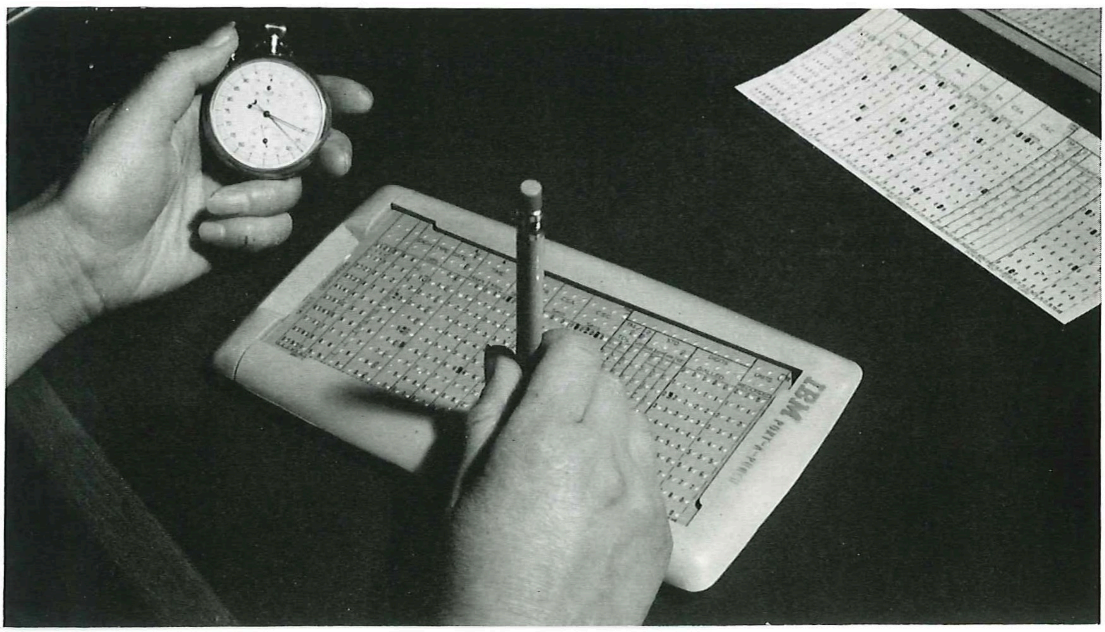
In one pass of the card file through an automatic gang punch at a speed of 100 cards a minute this route/type code is picked up from each master card and punched into each of the subsequent observation cards. Using the route/type code as a sorting key the cards can now be re-sorted into report order ready for summarising and analysis in the computer. Automatic print-out of the results, route by route with totals as required, forms an integral part of the computing process. Before being returned to the Telephone Area with the summaries, the cards are run through the high speed sorter once more to extract the masters for re-use in the next cycle.

The trial has shown that the use of a computer can simplify the procedure considerably. For example, it was previously necessary to refer to a list of dialling codes to obtain the charging rate for an STD call, and then, by referring to the duration, to determine whether the call was correctly charged, undercharged or overcharged. This calculation is now carried out within the computer and, in addition, printed details of any incorrectly metered calls are produced separately so that they are readily available for management purposes. Ease of sorting also facilitates the extraction of additional details on an *ad hoc* basis, and this should prove a most useful tool for service management and equipment planning purposes.

The trial began on 25 February, 1962, and the first month's processing was completed early in April. Summarisation, at present being carried out in the Service Bureau of International Business Machines, Ltd. who supplied the Port-a-Punches, will shortly be taken over by the Post Office's own computer.

The success of the trial has been due in large measure to the whole-hearted co-operation of all those engaged in the project and is an adequate answer to the remark recently made by Mr. R. H. McGann, LTR Telecommunications Controller: "There should be an awareness of costs at all levels of the organisation coupled with a readiness to modify long-established procedures when the need arises."

Close up of a supervisor at the Judd Street Observation Centre using a Port-a-Punch on an STD call.



THESE ARE THE AUTHORS

J. D. ANDREWS (*Electronics in Postal Mechanisation*) joined the Post Office in 1943 as a Youth-in-Training. In 1952 he was promoted to Assistant Engineer in WE Branch of the Engineering Department and in 1956 to Executive Engineer, Research Branch where he was responsible for circuit design for automatic letter facing and letter sorting projects. He became a Senior Executive Engineer in the electronic exchange division of Research Branch in 1962. Outside interests: diving and photography beneath the sea and sailing on it.

C. F. BEST (*Operator Services under Full Automation*) is a Chief Telecommunications Superintendent in the Telephone Mechanisation Branch of the Inland Telecommunications Department. He entered the Post Office in 1928 as an Assistant Traffic Superintendent serving in Colchester Area and the London Telecommunications Region, and was promoted to his present rank in 1952. Since joining ITD his main concern has been in the efficient utilisation of traffic-carrying plant. He has been closely associated with the evolution of the current standards of circuit provision and with the development of the trunk network under STD.

N. V. G. CHAPMAN (*ETE is Ten Years Old*) is a Chief Telecommunications Superintendent in the ETE who joined the Post Office in 1938 as an Assistant Traffic Superintendent. After six years with Royal Signals in North Africa, Italy and the Far East, he spent nine years in Wales as an Assistant Telecommunications Controller. He reached the ITD in 1957 by way of Nigeria where he served in the Posts and Telegraphs Department. With ETE since 1958, he is in charge of customer services, publicity and plant utilisation.

S. W. DABBS (*Farewell to the CTO*) has been associated with telephones rather than telegraphs for most of his career. Entering the Traffic grade 30 years ago, he has come up through the ranks to Principal Superintendent, having served in Leeds, Glasgow and London. He spent many years at Post Office Headquarters and was responsible for the traffic design of a new telephone system serving Colombo, Ceylon, for which the equipment is now being installed. Transferred to LTR Headquarters four years ago.

C. L. DANN (Joint author, *Speeding Telephone Service Observations*) is a Senior Executive Officer in a joint COMB/Savings Department computer team. He joined the Savings Department in 1938 and served in the RAF in World War Two. He was responsible for introducing a punched card scheme at the Savings Bank and in 1961, joined a COMB team now engaged on an automatic data processing project at the Savings Bank.

R. A. JACKSON (*GENTEX—and How it Works*), a Senior Telecommunications Superintendent in ETE, entered the Post Office in 1939 as a Youth-in-Training at Great Yarmouth. After serving with Royal Signals from 1943 to 1947, he was promoted to Assistant Engineer and attached to the Ministry of Supply's Signal Research and Development Establishment. In 1950 he transferred to the Bournemouth Telephone Area as a Telecommunications Traffic Superintendent and in 1959 took up his present appointment in the Overseas Telegraph Operations Group.

R. R. WALKER (*New Clocks for TIM*) joined the Post Office as a Youth-in-Training in the Engineering Department Research Branch in 1942, and is now a Senior Executive Engineer concerned with magnetic recording devices and loudspeaking telephones.

F. A. WYETH (Joint author, *Speeding Telephone Service Observations*) is a Senior Executive Officer in the Central Organisation and Methods Branch. He joined Gloucester Telephone Area as a Youth-in-Training in 1936 and was later employed in the Engineering Department Training School. In 1947 he became an Assistant Traffic Superintendent at Blackburn and in 1955 moved to the Inland Telecommunications Department as a Senior Telecommunications Superintendent. He spent three years in Nigeria as a Telecommunications Controller and, since 1961, has been engaged on automatic data processing projects.

★ ★ ★ ★ ★ ★

CORRESPONDENCE

THE underwater pictures of submarine telephone cables in your Autumn 1962 issue must have delighted many readers. However, the text that accompanied them is open to challenge.

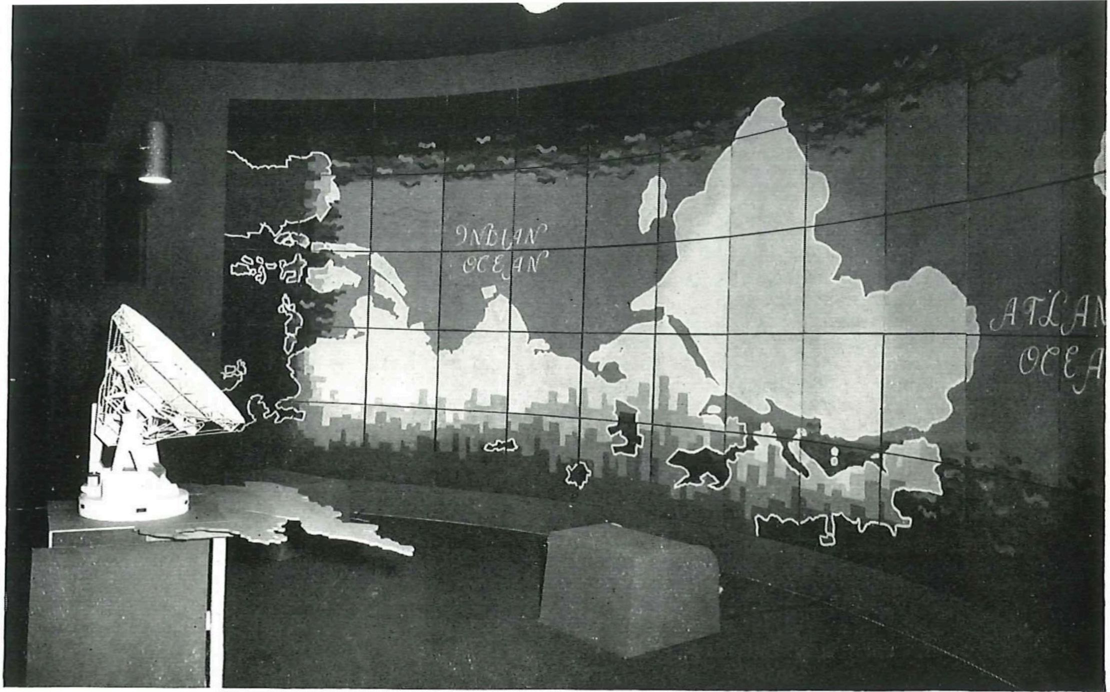
The TAT III cable will indeed use American lightweight cable and will be the longest submarine telephone cable—over 3,500 nautical miles long—then in existence. However, lightweight cable is not new and is certainly not an American invention; it is being used on the Commonwealth Cable, now being laid between Australia and Canada. This, the longest submarine telephone system in the world, will be more than 8,000 nm long and will include one section of 3,007 nm, between Fiji and Hawaii.

The development of lightweight submarine cable is interesting. A book dealing with telegraph cables, published as long ago as 1898, mentioned several primitive forms dating back to 1850. All were obviously unsound designs.

Nothing more seems to have happened for nearly a hundred years until, in 1951, Dr. Brockbank, of the Post Office Research Station, applied for a patent covering the light-weight type of construction and, working in co-operation with Submarine Cables, Ltd., started to develop a practical cable which was first tried out in a deep-sea trial in 1956 and successfully laid on the 2,070 nm CANTAT route, completed in December, 1961. This was the first deep-sea single-cable submarine telephone system in the world and included about 1,500 nm of lightweight cable of Post Office design. With the completion of the Pacific cable, more than 9,000 nm of British lightweight cable will have been laid.

The Bell Telephone Laboratories have adopted the lightweight cable principle and developed their own particular design. With the American Telephone & Telegraph Co. Ltd. now embarking on an extensive programme of lightweight cable laying, it looks as if the use of conventional deep-sea armoured cable is now at an end.—R. H. FRANKLIN, Staff Engineer, LMD Branch, Eng. Dept.

* The *Journal* is grateful to receive this information, but points out that it did not say that the lightweight cable was new or an American invention.



As a model of *Telstar* sweeps across the sky its course is tracked by the model of the Goonhilly steerable dish aerial.

THE POST OFFICE ON SHOW

ONE of the outstanding and most popular exhibits at the 1962 Radio and Television Show was the Post Office stand which traced the story of telecommunications through the ages—from the day almost a century ago when a Cambridge professor first thought of the laws controlling wireless waves to the spanning of the Atlantic last July by way of *Telstar*.

Those who think of radio and television in terms only of the BBC and ITV had their eyes opened to the vast amount of work the Post Office puts in behind the scenes, providing and manning the links and always seeking new ways to improve radio and television services.

Taken round on a movable platform, spectators saw an animated model of Marconi sitting at a table in Poldhu, in Cornwall and listening to the first wireless sounds from Newfoundland, and heard a recording of his voice explaining his experiments. Then they were shown how the national television network is controlled by a Post Office switching centre and how the programmes originated by the programme companies are switched all over the country to ITA transmitters. At the end they stepped out into a room where a working model of the Post Office experimental satellite communication station at Goonhilly, in Cornwall, tracked a model of *Telstar*.

This year's exhibition celebrated the 40th anniversary of the beginning of broadcasting in Britain and the start of a new era in television. For the first time a continuous programme was shown on the 625-line sets of the future. These fall into two categories: the "switchable" sets which have a built-in facility to make them immediately usable when the new 625-line, ultra high frequency transmission begins, and the "convertibles" containing additional components which, when plugged in, make them a dual standard or a 625-line receiver only.

Some of the switchable sets, with 19-inch screens, cost £65, plus £5 5s. for the optional ultra high frequency tuner needed to receive the new transmission, while the price of the "convertibles" ranges from £58 to £64.

For the first time, too, colour films, transmitted by land-line from the BBC studios at Lime Grove, were shown on experimental 625-line sets demonstrated by 14 manufacturers. Five television and sound programmes, including one for the hundreds of transistor portable radio sets, were used to demonstrate equipment, all being controlled from one central point.

The rapid rate of development of transistors was given added point by a tiny battery-operated transistor television set—weighing only 17 lbs. and with its own telescopic built-in aerial and a eight-and-a-half inch screen—which will last for four hours before needing to be re-charged.

This animated model shows Marconi (left) listening to the first wireless sounds received from Newfoundland.

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THE Post Office's new television detector car was also on show at Earls Court. It is one of nine new cars, employing a more advanced method of detection, to replace the existing television detector vans which have been in service for the past ten years.

The system at present in use relies on the deflection of the magnetic radiation from the line deflection coils in the television receiver. The signals are intercepted by horizontal screen loops at the front and rear of the car and are of equal strength when the car is immediately outside the house containing the receiver.

The new system employs a direction-finding aerial and a panoramic receiver to detect the radiation from the frequency-changing oscillator on a television or VHF radio receiver. The car need not be directly outside the house for detection to be achieved and the operator can also determine how many receivers are operating, their approximate location in the house and which programmes are being received.

The new television detector car on trial in a London street. Note the direction-finding aerial on top of the vehicle which accommodates a crew of four.

AUTOMATISATION COMPLETE IN HOLLAND

TO commemorate the complete automatisation of the Netherlands Telephone system—carried out on 22 May when the last manual exchange at Warffum, in Groningen, was replaced by a fully-automatic exchange—the Netherland Postal Services have issued a set of special postage stamps, valued at four, 12 and 30 cents.

The four-cent stamp shows a white dial on brownish-red background and the wording "Automatisation of the telephone network completed." The 12-cent stamp, in amber and white, bears a diagram of district exchanges and connections with sector and end exchanges and has the same legend, while the 30-cent stamp has an ochre dial and a white and blue arch on a deep green background.

The Netherlands telephone network today has about 1,300 fully-automatic exchanges and 168 inter-connected repeater stations.

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New Sound and Vision Links

THE Post Office provided new sound and vision links for two Independent Television Authority transmitters which came into service in September.

They are the Channel Islands transmitter at Fremont Point, Jersey, and the station at Preseli, Pembrokeshire, to serve South West Wales.

A special type of link was provided for the Channel Island service. Normally, microwave radio links requiring relay stations within optical range of each other are used to connect transmitters with the main ITA network, but in this case the 90 miles of sea separating the Jersey transmitter from the mainland was too big a hop for microwave radio transmission.

Instead, therefore, signals from the ITA transmitters at Stockland Hill and Caradon Hill are picked up on Alderney where two parabolic reflector aerials, 30 ft. in diameter, have been mounted on a hillside and directed towards Stockland Hill. An open wire aerial directed at the Caradon Hill transmitter provides an alternative source of signals. From Alderney signals are carried by microwave link to the Jersey transmitter at Fremont Point, which is also linked by coaxial cable with the Channel Television studios, six miles away.

The transmitter at Preseli will be linked to Cardiff by a new Post Office microwave radio link of three hops which will provide vision channels for the BBC to West Wales and later telephony to West and North Wales. There is access at Cardiff to the Post Office national network switching centre and the Wales Television studios.

Mr. Charles Acton Retires

Mr. Charles Acton, one of the world's best-known specialists in international radio regulations, has retired from the Canadian Department of Transport. For the past 25 years he had been superintendent of radio regulations and international agreements in the Department's telecommunications and electronics branch.

In 1959, Mr. Acton, who in World War Two was responsible for Allied general frequency co-operation in Canada and the North West Atlantic, was elected chairman of one of the biggest technical conferences in history—the 117-nation Seventh Administrative Radio Conference of the International Telecommunication Union at Geneva.

A New Director for the North East

MR. Donald Knapman, an Assistant Secretary in the Inland Telecommunications Department at Post Office Headquarters since 1956, has been appointed Director of the North Eastern Region in succession to Dr. L. E. Ryall, who retired on 14 November.

Mr. Knapman, who joined the Post Office as a Probationary Inspector in the Engineering Department in Birmingham in 1926, was an area engineer at Swansea from 1938–46, Telephone Manager at Cambridge from 1946–49 and Telephone Manager at Cardiff from 1949–51. He was then appointed to take charge of the Post Office Management Training Centre, a post he occupied until 1953 when he became Staff Controller in the London Telecommunications Region.

Dr. Ryall entered the Research Branch of the Engineering Department in 1925 and in 1939 became Regional Engineer to the Post Office in Scotland, returning to London in 1947 to become head of the Electronics Division at Dollis Hill. In 1951 he was appointed Deputy Regional Director of Home Counties Region and in 1956 Director of the North Eastern Region.

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A NEW RADIO TELESCOPE. Work has begun on a new 125 ft. radio telescope to supplement the existing 250 ft. telescope at the Jodrell Bank Observatory. It will operate on very high frequencies and will be used particularly to map radio emissions from interstellar space. It will also carry out work on radio stars in conjunction with the existing instrument.

STRAD FOR CREWE. Signal Transmitting, Receiving and Distribution—is being installed by London Midland Region of British Railways at Crewe.

Midland Region is the first commercial undertaking in Britain to introduce this type of high speed, electronic switching teleprinter system which receives teleprinted messages and relays them automatically and almost instantaneously in order of priority. Messages can also be stored in the system and relayed to their destinations at a later date or at any selected time.

The centre at Crewe will be completed by 1964 and the system will later be extended to include most main stations and depots in the Midland Region.

MARCONI'S YACHT RECOVERED. *Electra*, the famous yacht on board which Marconi carried out many of his experiments with radio-electric, radio-telephone and television communications, has been recovered from the beach near Zara, Yugoslavia, where she was stranded after a bombardment in World War Two.

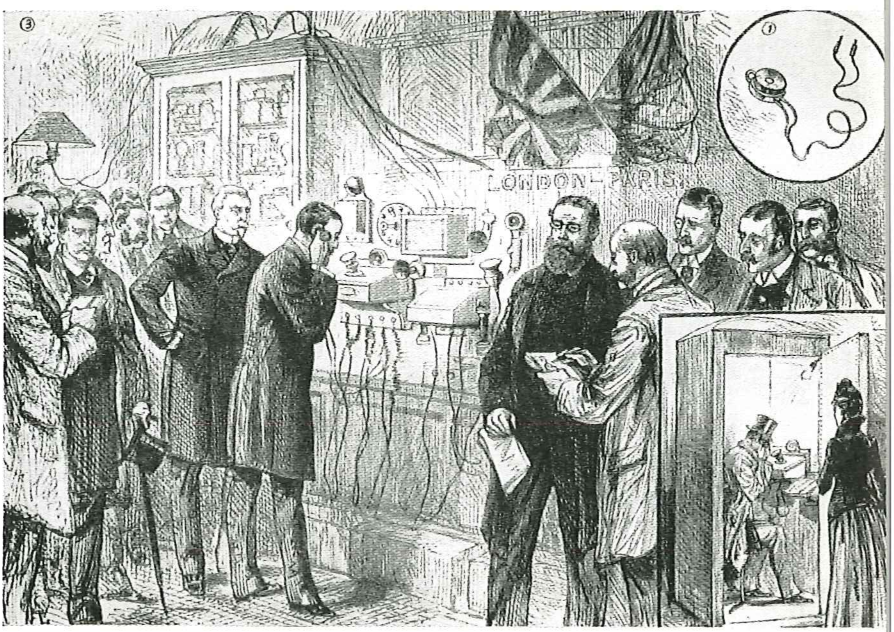
Electra is to be towed to Trieste where she will be repaired and then taken to Rome to be completely restored with all its original equipment.

FLASHBACK TO 1891

The rapid advances in telephony in this century are no more strikingly illustrated than in this picture published in the *London Illustrated News* 71 years ago.

The caption reads: "On 18 March, 1891, the first telephone communication between London and Paris was opened by way of a cable laid in the English Channel. Here, leading personalities in London are seen exchanging the first telephone conversations with those in Paris."

Early next year London subscribers with STD facilities will be able to dial direct to subscribers in Paris and it is anticipated that international subscriber dialling will later be extended to many other European countries.



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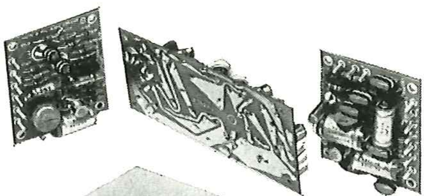
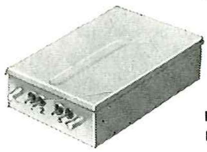
GROUP INDEX

These Advanced Features give the Vanguard **EXTRA PERFORMANCE**

UNIT PRINTED BOARD CIRCUIT ELEMENTS





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- 4 Watts Audio Output

Meets British, American, Canadian and Continental Specifications

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MUSEUM TOWER

This picture, taken in October, shows how the new 520 ft. high Tower at the Museum Telephone Exchange is taking shape. The main structure of the new exchange building is nearing completion and the whole project is up to schedule. The microwave radio links which terminate at the Tower will provide many more long-distance telephone and line-of-sight television circuits.

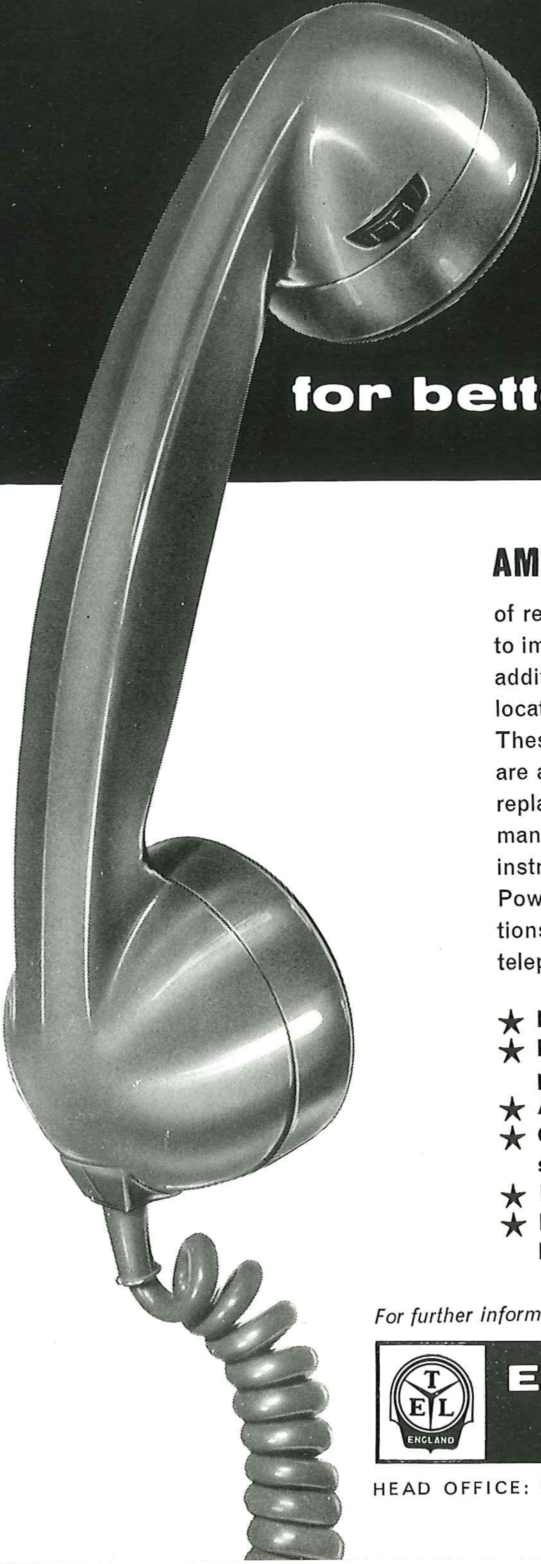
Publication and Price. The *Journal* is published in February, May, August and November, price 1/6. The annual postal subscription rate is 6/6 to any address at home or overseas.

Contributions. The Editorial Board will be glad to consider articles of general interest within the telecommunications field. No guarantee of publication can be given. The ideal length of such articles would be 750, 1,500 or 2,000 words. The views of contributors are not necessarily those of the Board or of the Department.

Communications. Communications should be addressed to the Editor, Post Office Telecommunications Journal, Public Relations Department, Headquarters, G.P.O., London, E.C.1. Telephone: HEAdquarters 4345. Remittances should be made payable to "The Postmaster General" and should be crossed "& Co."

GPO

Amplified Handsets . . . . .



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of reliable and high quality performance, have been designed to improve reception for subscribers with impaired hearing. In addition, they may be used with advantage in certain noisy locations where reception is inadequate.

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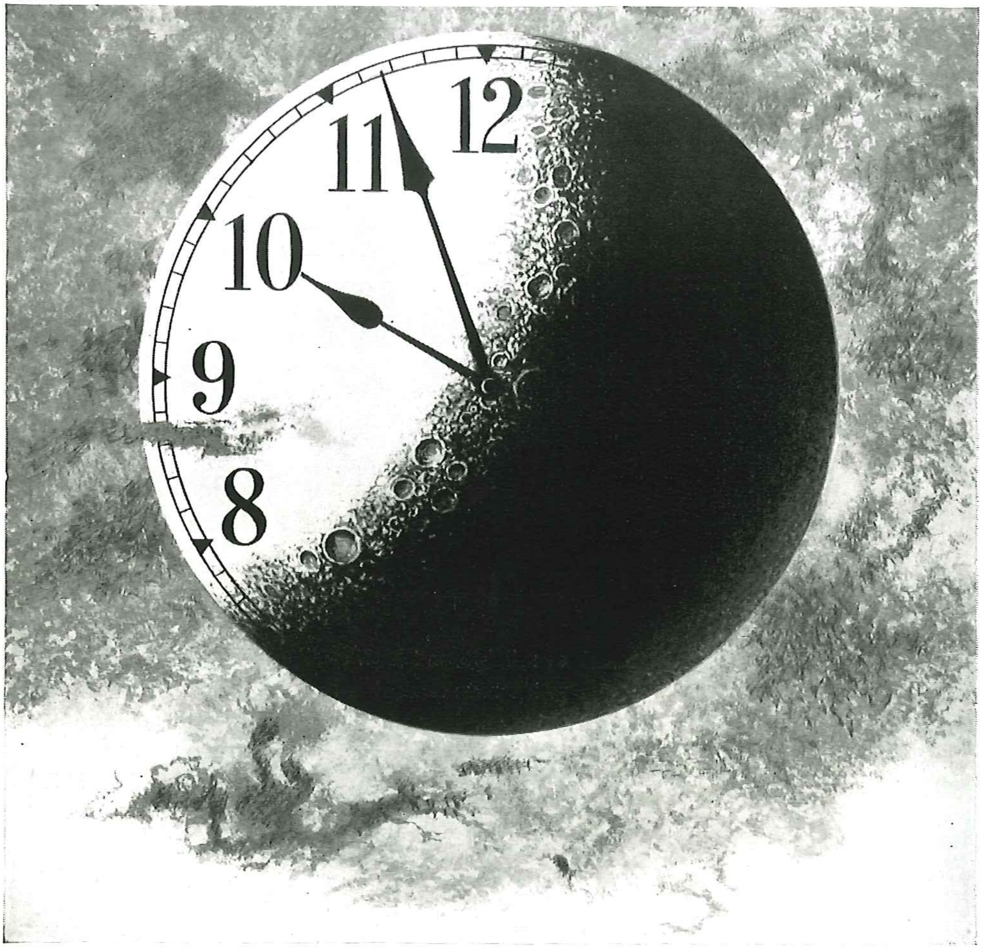
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8


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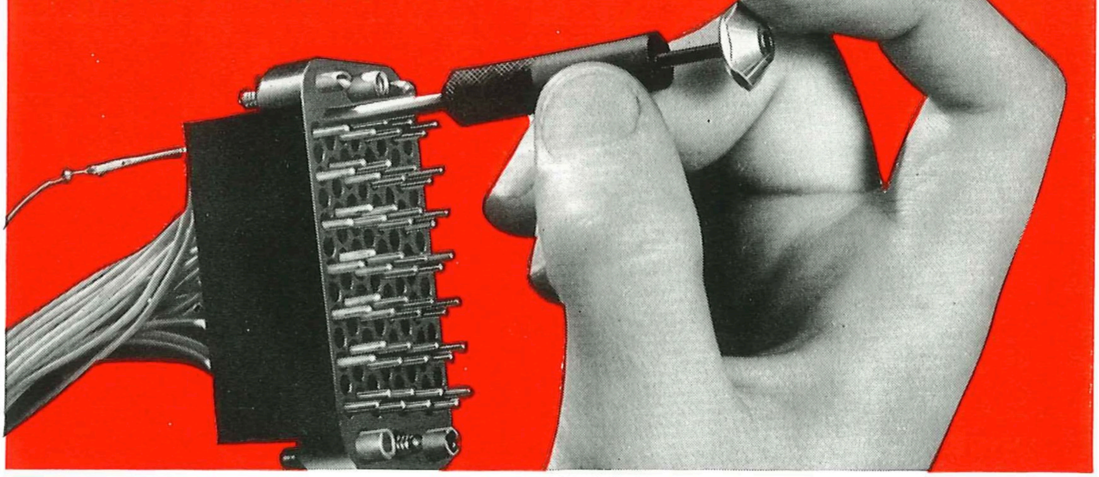

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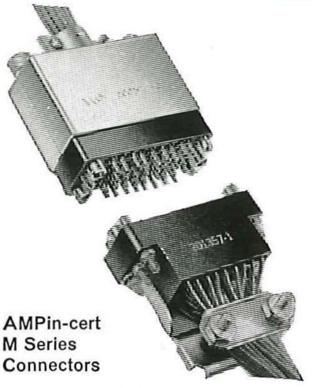

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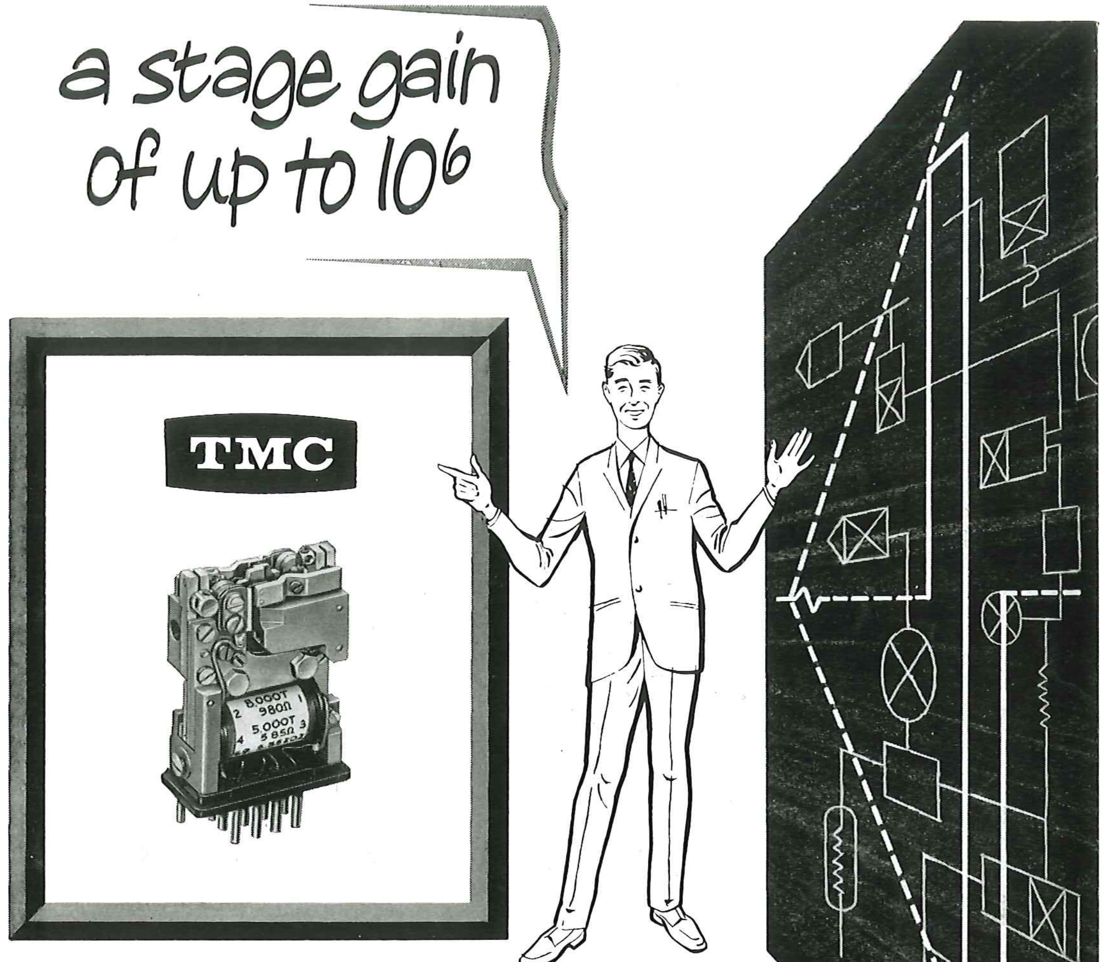

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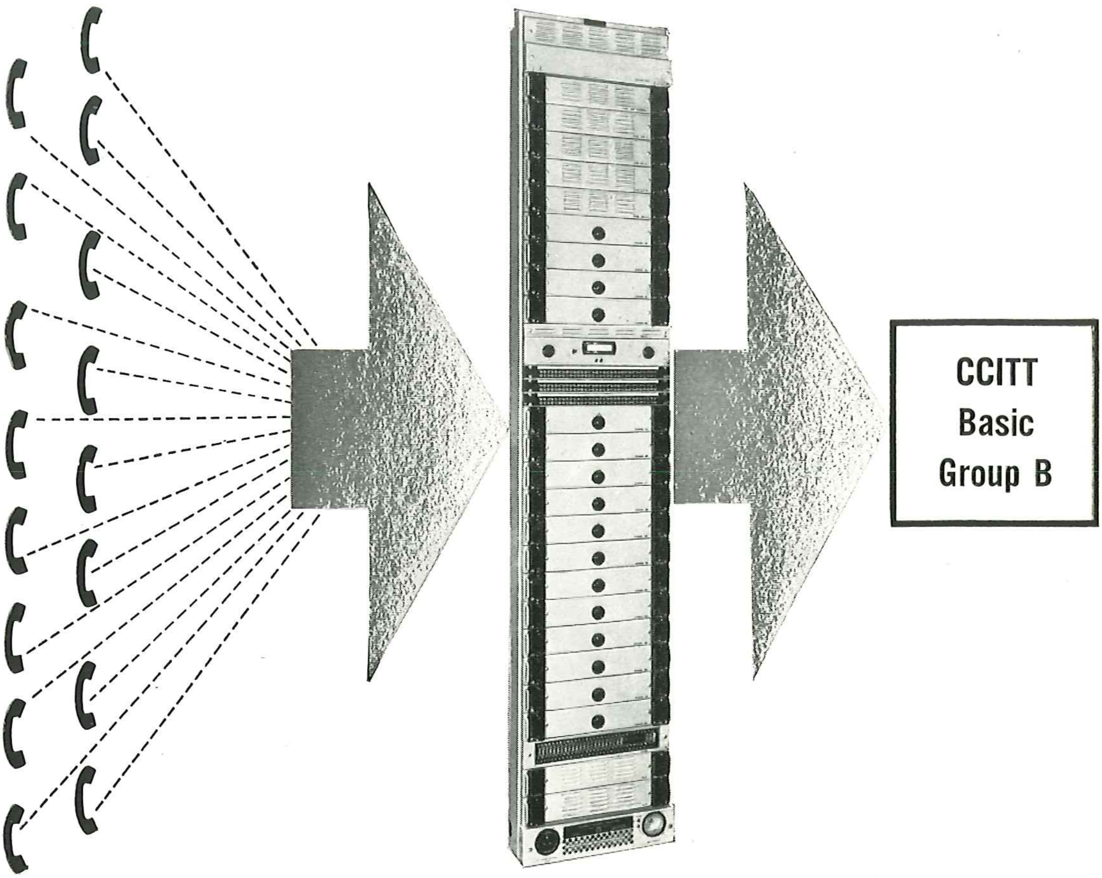

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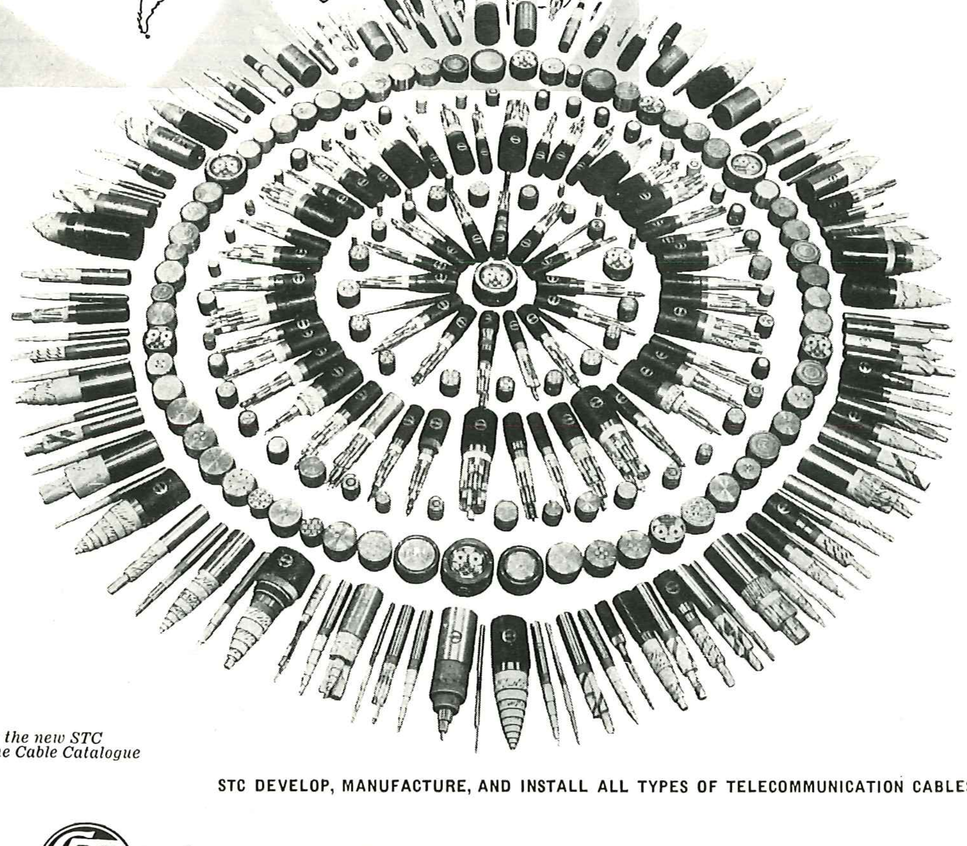

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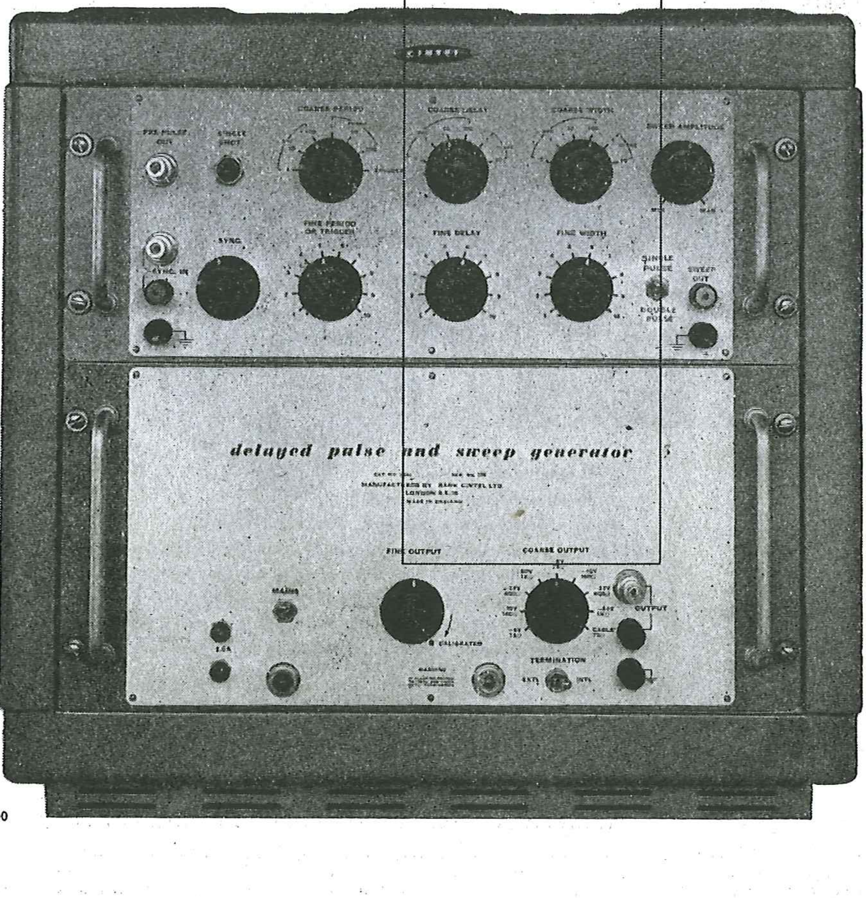

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